COAL AGE

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DEVOTED TO THE OPERATING, TECHNICAL AND BUSINESS PROBLEMS OF THE COAL-MINING INDUSTRY

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New York, March, 1934

Strike Two!

SHORT SHRIFT was given the appeal of the Progressive Miners of America by the National Bituminous Coal Labor Board in affirming the decision of the Bituminous Coal Labor Board for Division II upholding the contract between the United Mine Workers and the Peabody Coal Co. in southern Illinois. That an agreement, made in good faith, between the operator and the older labor organization existed was uncontroverted; the contention of the appellants that the validity of that contract was not involved in the question of which organization was entitled to speak for the employees was insupportable. To have ruled otherwise would have been an open invitation to industrial warfare and contract repudiation disastrous to orderly labor relations and to the cause of organized labor.

Realism in Utopia

INTERPRETATION of Section 7 (a) of NIRA has been a subject of controversy since the day the measure was introduced in Congress. Organized labor has accepted the section as a mandate for unionization; opposing employer interests have argued that the guaranties of the rights of minorities implied in the statute bar closed-shop contracts. NRA itself expunged "open" and "closed shop" from its vocabulary and inclined toward a viewpoint which embraced any number of groups bargaining collectively and individually with the same employer.

Under this idealistic interpretation, theoretically at least, a mine owner might be compelled to bargain collectively but severally with separate groups representing company unions, the United Mine Workers, Progressives and the National Miners' Union and also with workers who insisted upon personal and individual negotiations. Unfortunately, the spirit of tolerance is too weak to make such multigroup bargaining practicable. Recall the anthracite button strikes and the rueful admission by NRA that the proposal that an Illinois mine operate under contracts with both unions in that State was not workable.

The recent Presidential order on elections held under the supervision of the National Labor Board to determine who shall represent employees in collective bargaining under Section 7 (a), however, is highly realistic. Not only does the order provide selection by the vote of "at least a majority" of the employees voting but it also makes the men so chosen the representatives of "all the employees eligible to participate in such an election." This may be harsh on irreconcilable minorities but it should promote industrial peace on common-sense foundations.

No Sanctity in Size

PICTURING the small unit in industry as the victim of NRA code operations commands ready sympathy in which traditional national concern for the under dog and the numerical strength of these units play important parts. Much of the sympathy, however, is the product of inconclusive thinking, since it is based on the premise that the small unit is necessarily less efficient than its larger competitors and, therefore, is entitled to special privileges to

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offset these disadvantages. Such a broad generalization cannot be supported.

Some of the most efficient units in the coal-mining industry, for example, are to be found among the smaller producers and some of the less efficient among the larger ones that believed that mere bigness was in itself efficiency. The converse also is true. Therefore, to adopt size as the criterion and to create favored classes on that basis—especially where, as in coal mining, large and small units are in the same districts, tap the same labor markets and ship to the same consuming markets—would be to sanction, not correct, injustice.

Code regulation should encourage efficient management, regardless of the size of operation. Under equality of treatment within a given area on wages, hours and working conditions, the small unit that is efficient has the same chance to survive as the larger unit. To protect any inefficient unit—large or small—is neither socially desirable nor economically sound.

Chlorinating Coal

FEW RIVER WATERS are more highly chlorinated than those of parts of the United States, apparently because of the large quantities of salt water from oil, gas and brine wells. Thus the Allegheny, near Kittanning, Pa., in 1906-1907 showed, as a result of tests of 36 composite samples, 16.10 per cent of its salts as chlorine. The Muskingum, near Zanesville, Ohio, and the West Fork of the White River, near Indianapolis, Ind., showed even more.

Such rivers may supply chlorinated ground water and thus impregnate coal with chlorine and, when water from them is used for washing, chlorine will be added to the washed coal and will stay in the coal, where the salts in the water are concentrated by heat in the process of drying. Especially is this condition to be feared where the streams are low and the well-discharge water consequently is not greatly diluted by mixture with rain water. When the chlorine in wash water comes from the coal, its quantity may build up with reuse, but that cannot happen to the same degree when the chlorine is in the water source and natural evaporation alone causes concentration. Just how much chlorine is fed to the coal in washing with highly saline river waters is worthy of study, if only to prove it negligible.

Railroad Favoritism

RAILROADS are still endeavoring to persuade the bituminous industry that the carriers should be a favored class of buyers in the matter of prices. The point is made that prices have increased approximately 33 per cent in the Eastern fields, against about 2 per cent west of the Mississippi River, but the relative wage changes in the two sections of the country are adequate answer to that particular comparison. Just why the railroads should be favored at the expense of other consumers or at the expense of reasonable profits for the coal industry is still unanswered.

Price-Fixing

BELATED REFUSAL of NRA to approve the Code of Fair Competition for the Solid-Fuel Industry until the retail coal merchants consented to radical revisions in the price-control provisions of that document gives ominous warning of shifting policies on the part of the administration. As originally submitted and apparently accepted without objection until the retailers began to press for explanation of the delay in approval, the code provided for the establishment of minimum prices in each division or trade area. As finally approved, such minima may be fixed only after declaration that destructive price-cutting within an area or areas creates an emergency endangering the successful operation of the code, and then only after full hearings by the Code Authorities in the affected areas.

While the statement was made that NRA doubted the wisdom of permitting price-fixing in any retail code, the fact that the original proposals of the retailers so closely paralleled those incorporated in the Code of Fair Competition for the Bituminous Coal Industry cannot be ignored by thoughtful operators. The Consumers' Advisory Board, which, early in the history of NRA, was disposed to recognize the exceptional conditions in the natural-resource industries, more recently has been applying some of its peculiar reasoning to changes in coal prices. NRA itself has grown skittish on open-price provisions. All these developments strongly suggest that it would be wise for the producing end of the industry to keep its own house in order and to be prepared to defend the necessity for price control.

GOWEN BREAKER

+ Provides High Efficiency and Low Cost

In Anthracite Preparation

WHILE installation of new preparation facilities is motivated primarily by a desire for a cleaned product uniform in character and containing a minimum of removable impurities, experience has shown in a number of instances that other scarcely less important advantages may result. These may range from reduced labor, maintenance and power charges to an increase in the yield of both the larger sizes and total salable coal. Practically all of these benefits are being realized in varying degree at the new Gowen breaker of the Buck Mountain Coal Mining Co., Fern Glen, Pa.

This plant replaces an old jig breaker destroyed by fire on May 26, 1933. Capacity of the original plant was 1,000 tons of raw coal per shift of eight hours. Twelve jigs and three concentrating tables comprised the cleaning equipment, including two rock jigs installed to recover coal from the stove and nut refuse. By sizes, the coal jigs were allocated as follows: egg, two; stove, two; nut, three; pea, two, and buckwheat, one. Part of the buckwheat and all of the rice and barley were cleaned on the concentrating tables.

Design of the new breaker, equipped with two Chance cones for cleaning all sizes from egg to No. 4 buckwheat, inclusive, was started on July 1, 1933. Construction began on July 17, and the plant went into operation on Oct. 16, 1933. Capacity of the plant, designed and built by the Staples-Sweeney Mfg. Co., is 1,600 tons of raw coal or 1,000 tons of cleaned coal per shift of eight hours. Total cost of the entire plant was $120,000. Twelve men (Table I) are required for normal operation, as against 27 employed in the old plant with a smaller capacity (1,000 tons raw feed). This reduction in operating labor, apart from other savings, offsets the royalty charge on the cleaning process, with something left over.

In addition to improved cleaning results, more efficient operation has been reflected in a rise in the yield of salable coal per mine car and an increase in the percentage of prepared sizes. Preliminary experience indicates a gain of 300 lb. per car in the yield of salable coal, while the increase in prepared sizes (egg, stove and nut), due to the decreased handling made possible by the design of the new breaker, as well as to the absence of breakage in the cleaning operation, is conservatively placed at 15 per cent. The smaller number of cleaning units, conveyors and other auxiliaries, plus greater accessibility and an improved lubrication system, also is expected to have a favorable influence on maintenance and power costs.

Table I—Operating Forces at the Old and New Breakers, Gowen Colliery

	Old Breaker	New Breaker
Dumpers	3	3
Dump and picking bosses	1	..
Pickers	12*	2
Cone tenders	..	1
Shaker tenders	1	..
Jig runners	3	..
Loaders	2	2
Pumpmen	..	1
Utility men	..	1
Repairmen	4	2
Breaker engineers	1	..
Total	27	12

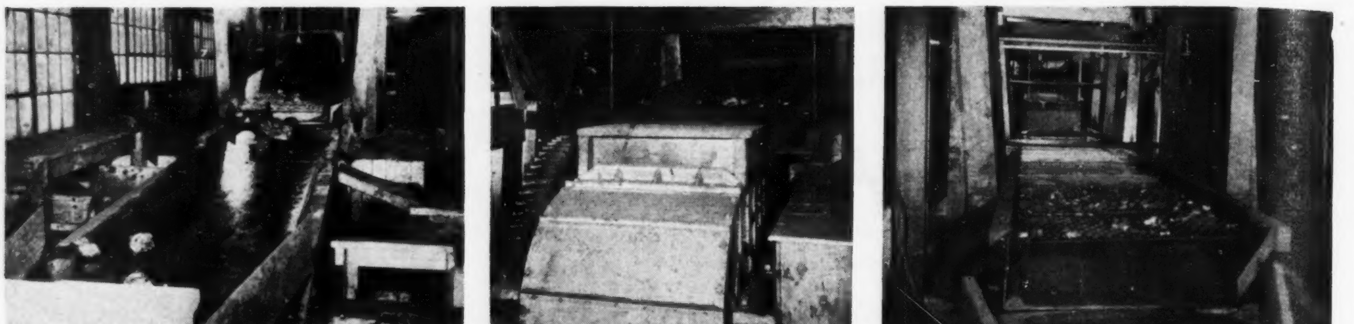
*Includes nine men picking slate after the jigs.

Raw coal and mine rock brought to the breaker in mine cars are dumped over a Goyne steam-operated horn dump in the top of the breaker. Rock drops through a flygate into the rock pocket, while the coal drops into a two-car hopper. A reciprocating push feeder, operated from the bull-shaker drive shaft, moves the coal onto the bull shakers, consisting of a 5x18-ft. top deck with 5-in. perforations and a 6x18-ft. blank bottom, or carrying, deck. Coal over 5 in. goes to a 5x20-ft. shaking picking table, while the minus 5-in. material is chuted to the broken shakers.

Refuse from the picking table drops into two bins, which discharge into the refuse cars from the side of the track opposite the rock hopper, while the coal (lump and steamboat) discharges into the No. 1 rolls, consisting

Gowen Breaker, Showing Mine Tracks and Refuse-Disposal Equipment, Upper Right.

Cone Floor, With Domestic Cone Front and Steam Cone Rear. Feed Shakers, Upper Right.



Left, Bull Shakers and Picking Table; Center, Broken Shakers and No. 2 Rolls; Right, Domestic Shakers Looking Back Toward the Cone Discharge.

of a Wilmot 36x34-in. compound-geared crusher with manganese steel segments, where it is reduced to broken and smaller and discharged onto the broken-coal shakers.

The broken-coal shakers (top deck, 5x24 ft.; bottom, or carrying, deck, 6x15 ft.) separate the feed into plus and minus 3½-in. sizes. The minus 3½-in. coal goes directly to the cone-feed shakers, while the plus material drops into the No. 2 rolls (same as the No. 1 rolls), which break it down to egg and smaller.

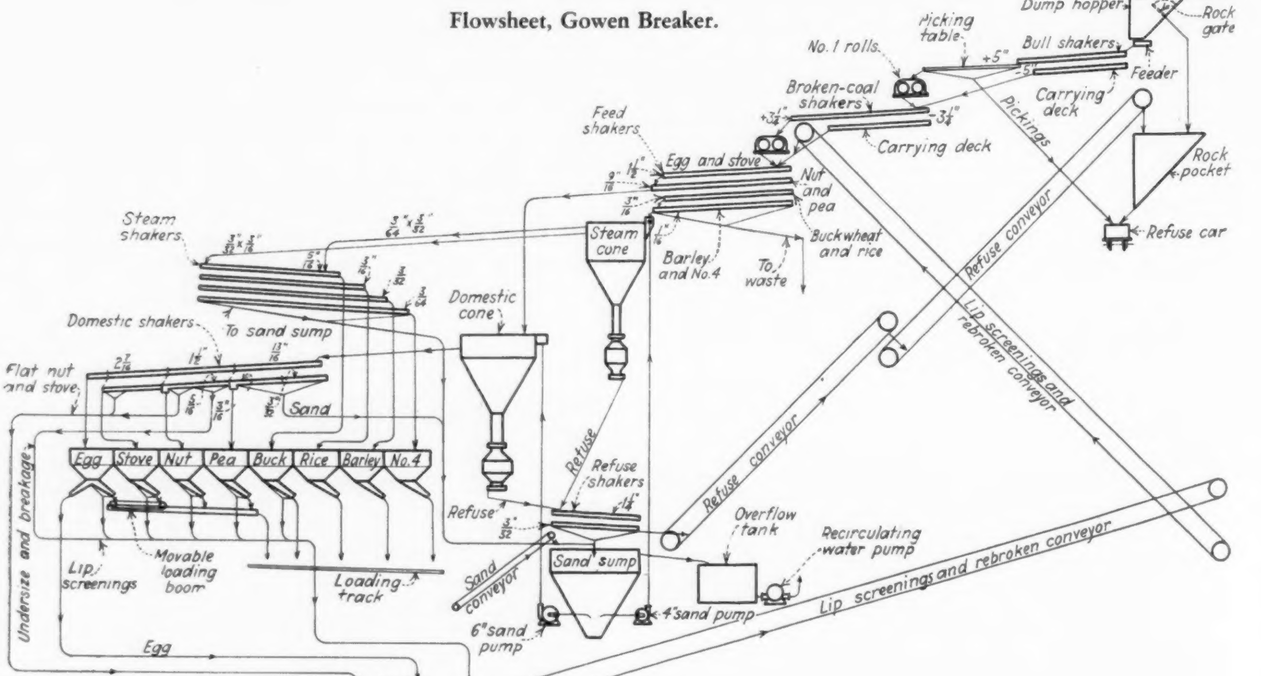
The cone-feed shakers consist of two pairs of decks, opposed in motion and driven from the same shaft. Sizes screened out are as follows: top deck, 5x27 ft., 1½-in. perforations, egg and stove; second, 5x21 ft., 9/16-in., nut and pea; third, 6x21 ft., 3/16-in., buckwheat and rice; bottom deck, 6x21 ft., 1/16-in. perforations, barley and No. 4 buckwheat. Minus 1/16-in. material through the bottom deck is sluiced to waste.

Raw egg, stove, nut and pea are chuted to the 10-ft. diameter domestic cone, while buckwheat, rice and barley and No. 4 go to an 8-ft. rectangular-top steam cone. To facilitate recovery of the No. 4 buckwheat, the 8-ft. cone discharge is split vertically, the bottom layer containing most of the larger sizes (buckwheat, rice and barley) and a high proportion of sand, while the top layer contains a relatively high proportion of the finer coal and a relatively low proportion of the finer sand. The top split is fed onto the steam shakers near the lower end of the top deck, which is below the point where the main desanding and sizing operation ends, thus simplifying the separation of sand from the top split product.

The domestic cone at Gowen is fitted also with equipment for removing silt, consisting of a siphon discharging near the end of the third deck of the steam-coal shakers. The siphon inlet, which is placed below the surface of the water but above the sand line, is provided with ¼-in. round holes, and removes silt, together with some coal over 3/64 and under ¼-in. not removed on the feed shakers.

Washed coal and sand from the domestic cone flow onto double-deck domestic shakers—top deck, 5x39 ft.; bottom deck, 6x39 ft. The top deck is equipped with 1⅝-, 1½- and 2 7/16-in. perforations. Egg is discharged over the end; pea, nut and stove drop to the bottom deck, which is equipped with 3/32-in. desanding perforations and 3/16- and 5/16-in. openings for removing undersize and breakage. Pea and nut dropped from the top deck are discharged at the side of the bottom deck to the washed-coal pockets under the shakers; stove is discharged over the end. Sand from the desanding jackets runs by gravity to the sand sump, and undersize and breakage are chuted to the recirculating con-

Flowsheet, Gowen Breaker.

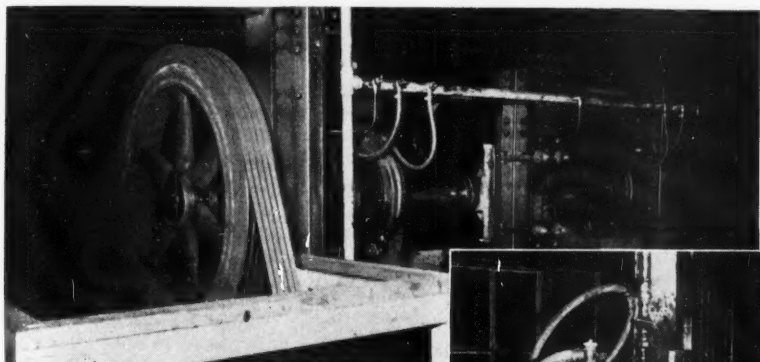


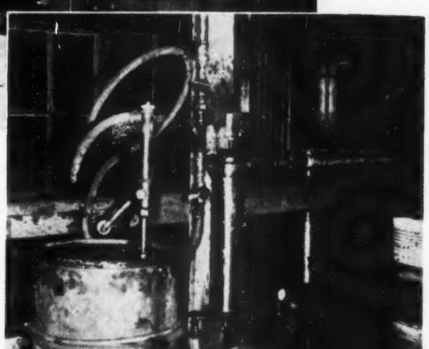
veyors, which discharge onto the feed shakers.

"Flat pickers" are inserted at the lower ends of the nut and stove sections on the bottom deck of the domestic shakers for removing flats from these sizes. These are chuted to a Wilmot 12x18-in. double-roll crusher, which reduces them to pea and smaller, the crusher product discharging to the recirculating conveyors.

Normally, all but 20 per cent of the egg size is broken down, so the washed-egg pocket is fitted with an auxiliary gate feeding onto a chute leading to the egg rolls, a Wilmot 24x24-in. double-roll crusher. The crusher product, stove and smaller, also discharges to the recirculating conveyors.

Washed coal from the steam cone is desanded and sized on fine-coal shakers consisting of two pairs of decks opposed in motion and driven from the same shaft. Sizes made on the various decks are as follows: top, 5x18 ft., 5/16-in. perforations, buckwheat; second, 5x19½ ft., 3/16-in. perforations, rice; third, 6x24 ft., 3/32-in. perforations, barley; bottom deck, 6x27 ft., 3/64-in. perforations, No. 4 buckwheat. Material through the bottom deck goes to the sand sump.





Steam Shaker Drive, Showing Lubricating Attachments; Inset, Central Lubricating Station for Shaker Drives.

Both cones are provided with steam-operated slate gates, actuated by automatic controls so that the discharge of either cone may be continuously or intermittently automatic under control of the operator. The refuse drops onto a double-deck desanding shaker (top deck, 5x18 ft., 1¼- and 3/16-in. perforations; bottom deck, 6x18 ft., 3/32-in. perforations). Material through the bottom deck drops into the sand sump. This deck is equipped with angle bars at the upper end, which are fixed across the deck about ½ in. above the screen surface. Spacing between the angles is 3 ft., and they hold the refuse on the upper section long enough to facilitate complete desanding, which reduces both spray-water requirements and sand loss. After desanding, a transfer conveyor carries the refuse up to the main chain-and-flight refuse conveyor, which discharges into the rock bin under the dump.

Table II—Motor, Starter and Transmission Equipment at Gowen Breaker*

	Motor Type†	Hp.	R.P.M.	Starter	Transmission
Push feeder and bull shakers	W. R.	20	900	Magnetic	V-belts; spur gears to push feeder arm
Picking table, Nos. 1 and 2 rolls, broken shakers	W. R.	50	900	Magnetic	V-belts to line shaft
Cone-feed shakers	W. R.	20	900	Magnetic	V-belts
Domestic shakers	W. R.	20	900	Manual	V-belts
Steam shakers	W. R.	15	900	Manual	V-belts
Refuse shakers	W. R.	15	900	Manual	V-belts
Domestic cone agitator	W. R.	15	900	Manual	V-belts and bevel gears
Steam cone agitator	W. R.	10	900	Manual	V-belts and bevel gears
No. 1 refuse conveyor	W. R.	10	900	Magnetic	V-belts and spur gears
No. 2 refuse conveyor	W. R.	10	900	Magnetic	V-belts and spur gears
Recirculating conveyors	W. R.	20	900	Manual	V-belts and spur gears
6-in. sand pump	S. C.	25	1,200	Manual	V-belts
4-in. sand pump	S. C.	15	1,200	Manual	V-belts
Recirculating water pump	S. C.	50	1,800	Manual	V-belts
Sand supply conveyor	S. C.	3	900	Manual	V-belts and spur gears
Egg rolls	W. R.	15	900	Manual	V-belts
Flat rolls	W. R.	10	900	Manual	V-belts
Total		335			

*Does not include motors on four unit heaters, condensate pump for unit-heater system, loading boom and lubricating system.

†Designations used in this column apply to the following motor types: W. R , wound-rotor; S. C., squirrel-cage.

Separate pockets are provided for each size shipped, and lip screens are installed in the egg, stove, nut, pea and buckwheat loading chutes to remove degradation, which goes to the recirculating conveyors. These conveyors also handle condemned coal. Egg, stove, nut and pea are loaded by a traveling loading boom designed by the Staples-Sweeney Mfg. Co. and built by the Robins Conveying Belt Co. The boom is mounted in a frame which is equipped with wheels operating on a track made of steel angles. The feed end is supported on a shaft mounted in the frame, while the discharge end is supported by wire ropes attached to a motor-operated hoist. Tracks are laid on a 2-per cent down-grade to facilitate spotting by gravity, and a hand-operated drum and tail rope is used to pull the boom back to the upper end.

Cleaning results to date indicate an ash content in the cleaned sizes ranging from 8½ per cent in egg, stove and nut to 11 per cent in rice, barley and No. 4 buckwheat. Ash in the refuse (rice and barley sizes) averages 74 per cent. Sink and float tests at 1.70 sp. gr. show one-half of one per cent float in the domestic-cone refuse and much less than this in the refuse from the fine-coal cone. Sand consumption, in the light of preliminary experience, is not over 4 lb. per ton of coal, and indications are that this figure may be reduced materially.

Westinghouse squirrel-cage and wound-rotor motors are used in the Gowen plant. Table II shows the horsepower and type for the various applications. Incoming power lines connect onto busbars at a central control and distributing station, where the safety switches controlling the various circuits are located. With one or two exceptions, starters are located at the respective motors, and pushbutton stations are installed at convenient locations for stopping any piece of equipment in emergency. Texrope or Texrope-and-spurgear drives predominate.

All shakers are equipped with flexible wood hangers, flexible wood connecting rods and brass-bushed eccentrics, and all shaker drives are lubricated from one point by the Ideal system. Foundations required 250 cu.yd. of concrete, and 233 tons of structural steel (fabricated by the McCarter Iron Works) was used in the breaker frame. Roofing and siding consists of Robertson asbestos-protected metal sheathing and the breaker is heated from a separate boiler plant by unit heaters.

Water from the mine is used in the breaker, and is brought in in Wyckoff wood-stave pipe. Two Morris centrifugal pumps (one 6-in. and one 4-in.) are employed to return the sand from the sand sump to the domestic and steam cones, respectively. The overflow from the sand sump is pumped back to the spray on the feed shakers by a 6-in. Allis-Chalmers centrifugal pump. Clean water for make-up enters the system through sprays on the domestic and steam sizing shakers. Refuse disposal is based on the use of cars and a steam locomotive operated by a two-man crew.

JEWELL RIDGE

+ Reverts to Private Power Generation With New Plant 6.6 Miles From Mine

"I EXPECT the saving to pay for the plant in less than five years," said George W. St. Clair, of Tazewell, Va., president of the Jewell Ridge Coal Corporation, when asked why the corporation recently spent a large sum to construct a modern generating station instead of continuing to purchase electric power. The new plant, which was put into use late in 1933, is located beside the Clinch River at Richlands, 1,900 ft. above sea level and 6.6 miles from Jewell Ridge, Va., where the mine tipple is located. Permanent but not elaborate construction, simplicity of design, and provisions to facilitate "good housekeeping" and maintenance are evident in this 2,000-kw. condensing plant. The planning and construction were handled in a way entirely different from usual practice. Other improvements made in 1933 include a new steel tipple and a town water-filtering and storage system.

Jewell Ridge mining history began in 1901 when Mr. St. Clair secured optional contracts on 110 tracts of land in Tazewell and Buchanan counties, Virginia, and in McDowell County, West Virginia. The tracts, purchased the next year, comprise over 18,000 acres within one boundary. Although this land borders the well-known mining properties of the Pond Creek Pocahontas Co. and New River & Pocahontas Consolidated Coal & Coke Co. (Berwind), both shipping on the Dry Fork branch of the Norfolk & Western Ry., and is in the Pocahontas-Tug River district, the outlet for the Jewell Ridge coal is at the southwest corner of the property in Tazewell County, on the Big Creek branch of the Clinch Valley division of the N. & W. The coal mined at Jewell Ridge contains approximately 21 per cent volatile, is low in ash, and the fusion temperature is 2,560 deg.

Mining was started in 1911 with a temporary direct-current power plant which was discontinued in 1915 in favor of purchased power. Annual production of the mine was between 60,000 and 100,000 tons until 1920, when Mr. St. Clair retired from his law practice to devote all of his time to the mine. Each year thereafter production was increased and in 1929 over 500,000 tons was shipped. This rate was maintained or increased through the "lean" years and recently production was stepped up to 3,000 tons per day. The Virginia Smokeless Coal Co., of Bluefield, W. Va., an affiliated organization, is the exclusive sales agent of this "Jewell Pocahontas Coal."

Electric power cost was approximately \$5,000 per month and the unit cost of energy for the year 1932 was 1.78c. per kilowatt-hour. The 15-minute maximum monthly demand fluctuated between 960 and 1,080 kw. and the yearly consumption of electricity exceeded 3,000,000 kw.-hr. It is expected that the unit cost of electricity produced by the new generating plant will be 8½ mills per kilowatt-hour, figuring depreciation at 5 per cent and interest at 6 per cent. The plant fuel is marketable slack, and plant operation is charged with this fuel at prevailing market price.

Location of the plant at Richlands required the building of 6.6 miles of transmission line, mostly over property not owned by the coal company, and has the lasting disadvantage that the plant fuel must be shipped in railroad cars, but the lack of a water supply at the mine left no alternative than to locate the plant on the Clinch River. Minimum flow of this stream is many times the requirement for boiler feed and condenser cooling.

For several years prior to 1933 Mr. St. Clair had been investigating the economics of generated power and had received proposals from several interests engaged in engineering, sale of equipment, or construction. Late in 1932 he reached the decision that, if built during the period of low costs, the plant was certain to prove a good investment. Accordingly he proceeded with the plans, but in a manner different from that usually followed.

He recognized that a final decision as to plant capacity and spare equipment must be based to a great extent on future plans of the company and that this forecast could be provided only by executives of the coal company. In the background was the possibility that two or three other mines might be opened on the property at some future date. Also he wanted to obviate any tendency to select equipment on any other basis than a strict analysis of service and efficiency balanced against first cost and operating maintenance.

With those considerations in mind, he decided to hire on a salary basis an electrical engineer experienced in steam-power-plant design and operation, but with the clear understanding that the employment was only for a few months. By personal interview with several men recommended by a prominent engineering club he selected the man to guide the job. This man handled all of the planning and designing at the mine office; therefore was on the ground to become acquainted with all of the facts pertaining to the power project and to consult with company officials on features of the plant design. After handling the design and purchase of the equipment he supervised construction of the plant, and was retained for a total of nine months.

After mine-load charts from a graphic demand meter had been obtained and analyzed, an idea formed as to the approximate size of plant required, and estimates made as to the total cost, the company management arrived at a limiting figure as an appropriation for the plant. This so-called bogey to the designing engineer proved its advantage and was adhered to in spite of the fact that a coal conveyor and bunker had to be eliminated in favor of a bucket-type push car and electric hoist. The conveyor and bunker will be installed later if experience further indicates their apparent economy.

The plant consists of two boilers each

310 hp. with underfeed stokers—boiler and stoker combination rated 250 per cent overload—and two 1,250-kva. (1,000-kw. at 80 per cent power factor) turbo-generators. One unit is practically a spare, because with present loads it should not be necessary to operate both units except for unusual peaks.

Boilers are the low-head water-tube type made by the Union Iron Works; are built for 250 lb. pressure and are equipped with "Elesco" 150-deg. intertube superheaters. Each boiler has three welded cross drums and has 3,100 sq.ft. of true heating surface—that is, with water on one side and hot gases on the other. They are set in battery with a 4-in. air space between battery walls and with 15-in. courses of high-aluminum brick at the clinker line. These settings were furnished by James T. Castle, of Pittsburgh, Pa.

Stokers are Westinghouse underfeed, single-retort, side-dump, steam-operated, and carry 63 sq.ft. of grate surface. Forced draft is provided by "Wing" blowers and induced draft by a Pratt-Daniel Ventura stack and blower driven by a Westinghouse four-speed motor. Ruggles-Klingerman equipment provides automatic control of forced and induced draft. The short Ventura stack with blower is an innovation for a mine power plant of this type, but was selected to reduce the investment. A high stack of permanent construction would have cost several times as much. The top of the Ventura stack is but 54 ft. higher than the grates, yet without operation of the blower it will supply draft to generate up to 150 boiler horsepower.

Bailey feed-water regulators and boiler meter are used. The latter draws a graphic record of steam flow, air flow and pressure on either boiler. Feed pumps, two in number, are McGowan duplex horizontal, 8x5x12-in. They are equipped with Foster excess pressure governor.

The feed-water heater is an open type, rated 40,000 lb. per hour. It is mounted directly above a hot-water storage tank 4 ft. in diameter and 12 ft. long. Both are on an elevated platform directly above the feed pumps. Raw feed water from the river is clarified in Cochrane sand-and-gravel filters and is further treated in Cochrane Zeolite softeners. In front of the boilers a Shepard electric hoist on a monorail supplies means of raising the ½-ton coal buckets from car to stoker hoppers. Ashes are loaded by hand and are wheeled out of the building.

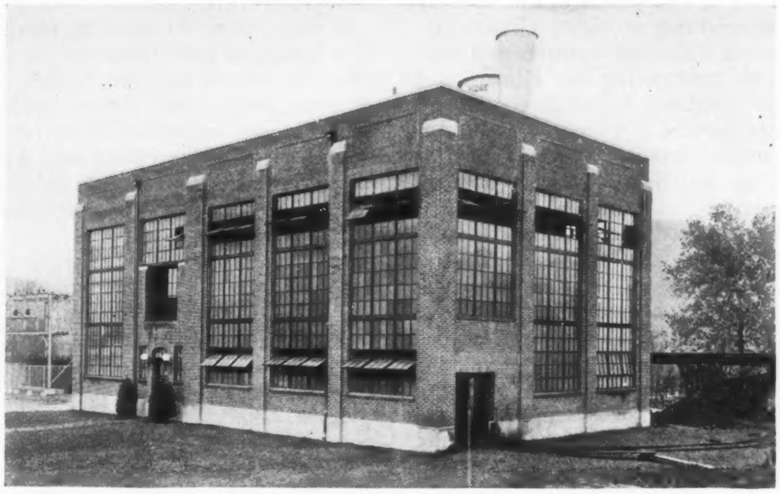
Construction of the 8-in. steam header was by use of pipe bends, acetylene welding and VanStone flanged joints at valves. Covering on superheated steam lines is double thickness 85-per cent magnesia put on with lap joints. Single thickness is used on other steam piping.

Turbo-generators and surface condensers are the latest type Westinghouse. Turbines, of the six-valve type, operate at 3,600 r.p.m. and on 225 lb. pressure, 150 deg. superheat. Generators operate at the same speed and are equipped with direct-connected exciters. Field-current collector rings are of a new square-thread grooved design which facilitates cooling and assures operation at low contact drop. Condensers are radial-flow type, 1,150-sq.ft., equipped with two-stage air ejectors having surface inter- and after-coolers. Circulating pumps are driven by 15-hp. motors, and the condensate pumps by 5-hp. motors. All four of these pumping units, including motors, are of Westinghouse manufacture. From river level to a tower storage tank, water for boiler feed and general purposes is elevated by two Ingersoll-Rand "MotorPumps" having General Electric 5-hp. motors.

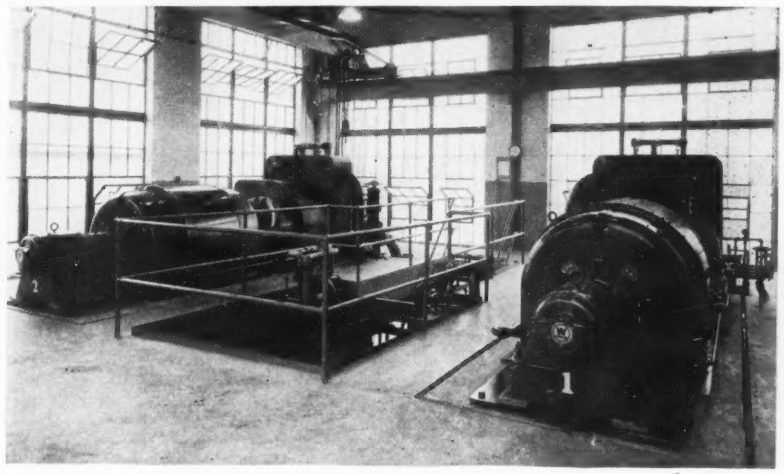
Power is generated at 2,300 volts and then stepped up to 13,600 volts at a transformer station located outside of the building. The plant switchboard is a Westinghouse product and consists of six panels and a swinging bracket. It is equipped with Westinghouse vibrating-type voltage regulator and a Type RA 15-minute totalizing demand meter. This meter will provide means for calculating what would be the cost each month if an equivalent quantity of power were purchased at the prevailing rate—this in order to calculate the saving each month.

The five Westinghouse induction motors driving plant auxiliaries are of the sealed-bearing type.

The power-house building is provided with an exceptional amount of window surface, is of permanent construction, and presents a highly pleasing appearance. Construction consists of 13-in. brick walls, steel roof trusses, steel roof deck, ½-in. Celotex insulation and Barrett 20-year built-up roofing. Floor dimensions are: boiler room, 42x42 ft., and engine room, 32x42 ft. Ample provision was made to facilitate operating maintenance. The engine room is equipped with a 5-ton Chisholm-Moore bridge crane and the boiler settings are arranged to allow ample space for con-



Built Beside the Clinch River, Six Miles From the Mine.



Turbines Are on the Second Floor.

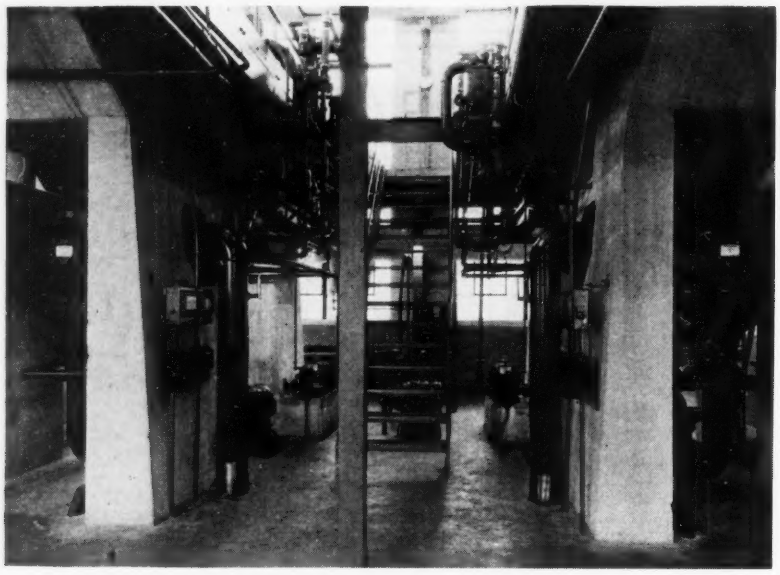
venient handling of boiler-tube renewals.

Lighting of every part of the building is exceptional day or night. Glazed surface proved a cheaper construction than walls and, considering the climate and the usual radiation losses of equipment, this large amount of glass surface is not objectionable from the standpoint of heating the building. Provision for unusually cold weather, however, was made by installation of two unit-heaters in the engine room. Artificial lighting of the engine room consists of eleven 300-watt reflector units mounted above crane height—an illumination allowance of 2.46 watts per square foot.

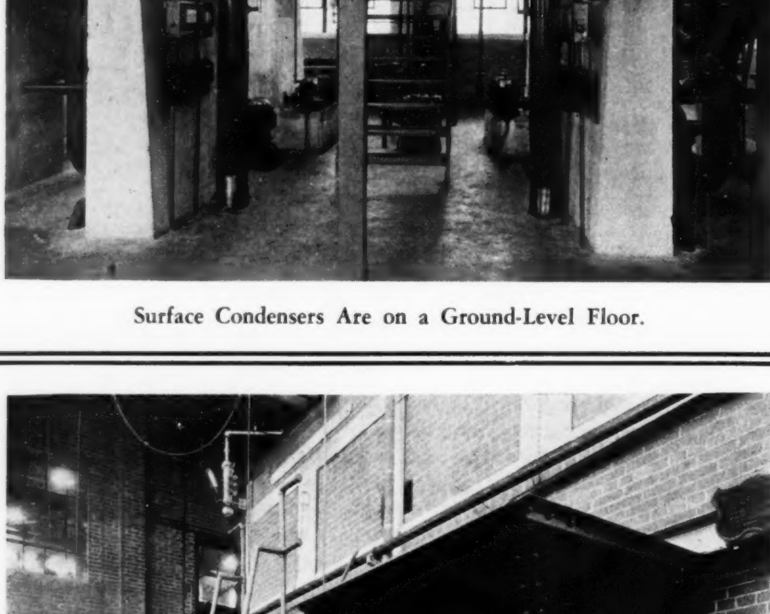
Several items of the plant construction were handled by the coal company. Contracts let included the building, boilers and settings, piping, and electrical equipment.

At the time of this writing representative operating data were not yet available. The boilers had been tested to 300 per cent rating, and over a period of several weeks' operation, using two turbines, the fuel requirement was 2.68 lb. per kilowatt-hour. This should be reduced when all is tuned up and the load carried on one turbine.

Substation equipment at the mine consists of five 200-kw. synchronous motor-generators, each 2,300 volts a.c. and 275 volts d.c. Four of the motors are 80 per cent power factor and one is 100 per cent. New transformers, reducing from 13,600 volts to 2,300 volts, were installed at each substation. These transformer banks and the one at the power plant each consist of four single-phase Westinghouse surge-proof units, one unit in each being a spare. The step-up transformers at the plant are connected delta on the low side and star on the high side. Westinghouse auto-valve arresters protect each transformer bank.



Surface Condensers Are on a Ground-Level Floor.



Two 310-Hp. Boilers With Underfeed Stokers.

The 6.6 miles of 13,600-volt transmission from the power plant to the mine is carried on locust poles which were cut on the coal company property. Conductors are No. 2/0 copper, and the lines include a ground wire which is connected to a permanent ground every 1,000 ft. Spans vary from 180 ft. to 1,600 ft. and at the latter the sag is 191 ft. A bid of $2,050 per mile covering construction of the line was rejected in favor of coal-company-supervised construction.

In December, 1933, it was estimated that the present cost to duplicate the plant would be between $75 and $80 per kilowatt. It would be less if the station were closer to the mine, if less permanent construction were selected for the building, and if old-style transformers were purchased instead of the new surge-proof type. The Jewell Ridge Coal Corporation was fortunate in having closed the contracts during June and July, 1933, before the general rise in prices. Edward R. Feicht, of Bala-Cynwyd, Pa. (outside Philadelphia), is the engineer put on the company payroll by Mr. St. Clair to handle the design and construction of the power project.

Approximately $80,000 was spent during the same year building the new tipple and constructing or improving a town water-supply system. The Morrow Manufacturing Co. was given the contract to build the new steel tipple on the same site as the original steel tipple which that company furnished over twenty years ago. Only a few parts of the old tipple were used in the new one, which is a 400-ton per hour modern screening and picking plant equipped with booms and loading onto four tracks.

For the town water supply there was installed at the mouth of a hollow near the tipple a 300,000-gal. ground-level storage tank and beside it a brick building containing filtering system and chlorinator. Two steel service tanks were erected to store the purified water. The company town centers on a beautiful site on the very top of the mountain, approximately 3,300 ft. above sea level, and it was necessary to erect one tank on an elevated steel tower near the high point. The company houses are so built, spaced and maintained as to give the town an unusually pleasing appearance. After seeing the town one is not surprised at the neat appearance of the power plant, even though it is six miles away. Both are typical of the way things are done at the Jewell Ridge operation.

LOAD DISPATCHING

+ Slashes Power Cost

At Appalachian Mine

By ALPHONSE F. BROSKY
Consulting Editor, Coal Age

AFTER five years of progressive mechanization, accompanied by changes in mining conditions, an Appalachian mine found that rising power costs threatened the maintenance of a satisfactory production cost. While the electrical loads added by mechanization helped diversify power requirements, they also involved the possibility of a load integration that would result in heavy penalties under the power contract, which was based on a 15-minute integrated demand charge, plus a kilowatt-hour energy charge based on load factor. To avoid this, the company developed a comprehensive load-control system which has reduced demand as much as 40 per cent, improved load factor from about 30 to 50 per cent, effected corresponding savings in kilowatt-hour and per-ton energy cost, and reduced maintenance costs.

Beginning with one room conveyor in 1926, the number has been increased gradually to sixteen. Each conveyor crew has its own cutting machine and power drill; pavement breakers were installed for lifting entry bottom. To better meet market demands, a dry-cleaning plant was erected. In addition, grades in newly developed sections increased sharply, with corresponding increases in haulage and pumping loads.

Some idea of the effect of these changes on power consumption is indicated in Table I, showing per-ton distribution in May, 1933, when 29,000 tons was produced. In that month, average cleaning-plant requirements were about 1.5 kw.-hr. higher per ton than normal—due to abnormal market conditions, reflected in an increase in crushing and mechanical cleaning of the larger sizes, which ordinarily are shipped after screening and hand-picking.

The mine lies in a basin. Sections mined prior to 1931 had fairly well separated contours; consequently, the grades encountered were not unusual. Since that time, however, adverse grades running up to 10 per cent have been met. Chain-and-flight-type conveyors are used in mining all rooms, room pillars and in entry development, and account for about 80 per cent of the production. Normal output—or 100 per cent tonnage for the period considered (1931 and 1932)—is 2,000 tons per day. The mine is double-shifted, each shift producing 1,000 tons. Surface-plant and hoisting operations are confined to the day shift; haulage on the night shift is limited to exchanging empties for loads and placing loads on storage tracks.

All haulage converges on the main dip entry, which has been extended to a length of two miles. The half of the entry next to the hoisting shaft is double-tracked—one track for loads and the other for empties (Fig. 1). At the end of the double track, the entry to the first of the sections now working is turned. The main gathering tracks and the control and dispatching station also are located at this point. Loaded cars are hauled to this terminal and from it the coal goes to the hoisting shaft and the rock to the outside through a drift opening.

Table I—Per-Ton Distribution of Kilowatt-Hour Consumption for May, 1933

Mine (including pumping)	7.52
Cleaning Plant	4.06
Hoist	0.978
Town and Boiler Water Supply	0.645
Ventilation	3.30
Lighting, Shop and Losses	0.77
Total	17.27

As no coal is hoisted at night, the capacity of storage tracks, established in old entries just off the main entry, has been increased to provide plenty of space. After shaft-bottom tracks have been filled to capacity, Storage Tracks 1, 2 and 3 are utilized in the order named. On the day shift, the dispatcher draws loaded cars from gathering and storage tracks furthermost from the shaft during periods of light electrical load; but, during periods of heavy load, cars are taken from the storage nearest the shaft, beginning with Storage Track No. I. Thus, the storage tracks are used to balance the electrical load for the entire system.

All major haulage is handled by three tandem units—two 13-ton, two 16-ton, and two 10-ton locomotives. These units also exchange cars between the main gathering track and section sidetracks, and take rock—about 400 tons daily—to the outside, a haul of about 7,000 ft. Where grades are heavy, the tandem units are operated in series, or at half speed, to keep down peaks. The number of loaded cars per trip is limited to 30. Prior to this limitation, trips of 65 cars were frequent. Cars average 1.65 net tons of coal. Much of the gathering is performed by low-speed locomotives.

These measures, together with trip dispatching, have had a marked effect on haulage efficiency, locomotive maintenance, power cost and hoisting schedules. Mine-car turnover has been increased, reducing the number of new cars required to maintain the output; and the number of main-line locomotives, with crews, has been reduced by two. Because locomotives are no longer overtaxed, motor efficiencies are higher and feeder and contact losses are lower. Electrical failures, such as armature coils, resistance grids, etc., have been reduced, and wear and tear due to frequent application of brakes have been minimized.

A 250-kw. steam-driven generator is utilized during day shifts as a load equal-

izer. This unit, a survival of the days of mine-generated power, is located in the power house near the hoisting shaft and takes over as much of the load created by starting trips as it can carry, thus cutting down purchased-power peaks. The dispatcher makes this scheme effective through scheduling. When a loaded trip is due to start from a gathering track, the dispatcher first assures himself that the electrical load caused by main-line haulage is light between this point and the shaft bottom. If the motor-generator sets already are heavily loaded, the steam-driven generator will be running light, and therefore will be in position to take over a share of the load created by starting a trip. Ordinarily, the steam-driven unit carries an average of 180 kw., but for periods of three to five minutes it may carry up to 340 kw.

Simultaneously with the beginning of this use of the steam-driven generator in the summer of 1931, the mine was rewired. Copper between substations was changed from 500,000 to 1,000,000 circ.mils and the smaller size was used for feeders from the stations to load centers. This change made it possible to maintain 250 volts at load centers. Balancing loads has changed the demands on the motor-generator sets from overload to below rating loads. This, together with wiring improvements, has reduced transmission losses.

Under the conditions set forth, nothing short of orderly control and balancing of equipment operation throughout the periods of heaviest demand for power would yield continuing relief from inordinately high energy billings. Most needed was a power-control system that would provide a leveling integration of sporadic loads with fewest inopportune interruptions to operation —a system that would enable the man in control to choose discriminately the time and place for an ordered delay.

The loads are such that automatic sectional demand limiters would serve little purpose, because they do not take operating schedules into account. For example, a mine section equipped with a demand limiter might readily establish an overload peak upon resumption of operation following a forced delay, only to be peremptorily shut down again at a time when cutting off its load was not really necessary for demand control over the entire system. Moreover, an overload peak might occur in all sections simultaneously, thus establishing an inordinately high demand, as the connected horsepower for each section is about 400.

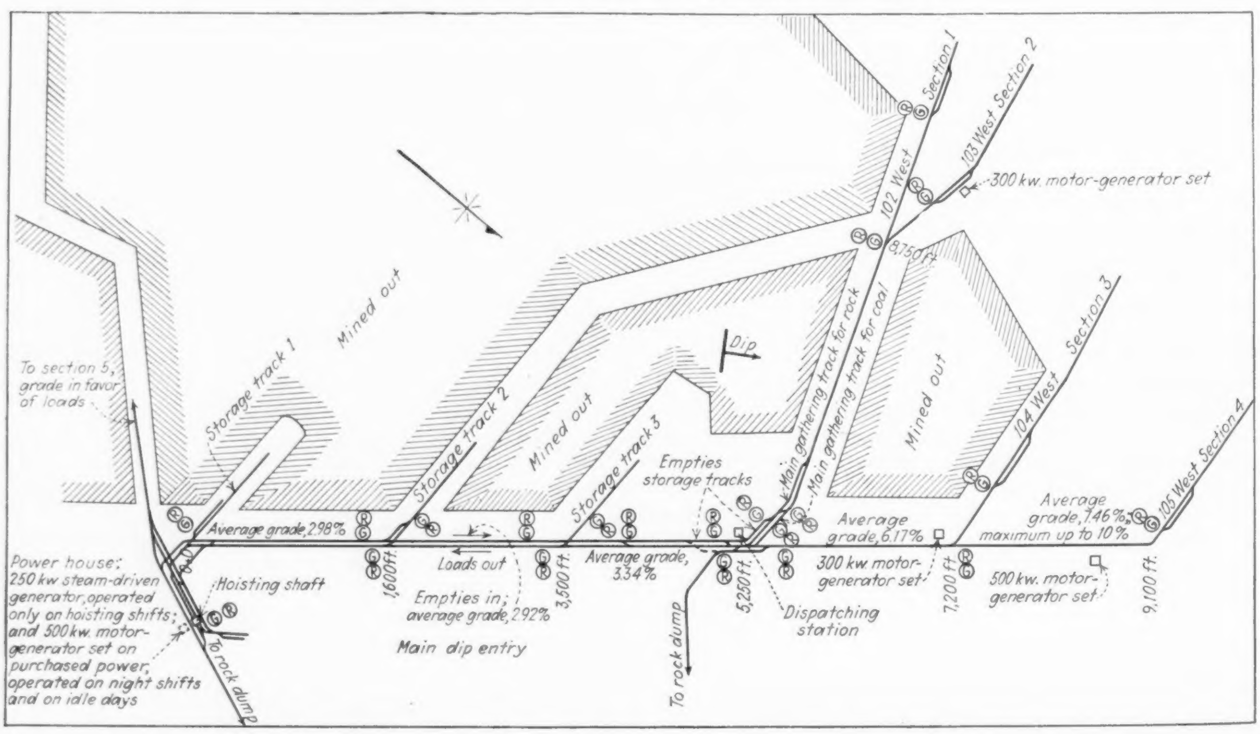
Little benefit could be derived from sectionalizing circuit breakers as such, if their automatic tripping features were to be depended upon to avoid sustained overloads. Heavy grades in the sections and the highly mechanized mining system in use would require a high setting of the overload relays for normal operation of equipment. Set at a cutout value that would minimize peaks, the breakers, without some additional means of control, would cause many interruptions to operation. The tendency then would be to set them higher and higher until, finally, they would be of little value in keeping down peaks. Sectionalizing circuit breakers are installed, but they function primarily as a protection against short-circuiting; they serve further, but through the load dispatcher, by providing automatic features in a remote-control system for cutting off or cutting in the electrical load on any mine section.

Telephone dispatching was rejected because considerable time would be lost thereby and because of the possibility of interferences. Moreover, telephones could not be applied to the control of power loads other than haulage. The telephone is a stand-by for and an adjunct to the control system adopted. Its primary purpose, however, is to meet the usual service requirements of mine business. The conventional system of automatic signals was ruled out because it could not compensate for abnormal conditions which would arise.

Search for a dispatching and control plan incorporating, as far as possible, the best features of these systems led to the development of the plan now in use. It is simple and dependable, and but one wire was necessary for each control or signal circuit, advantage being taken of other purpose conductors for completing the circuit. These features have made it possible to install an elaborate control system at reasonable cost. Approximate investment in wiring, signals, switches, dispatching station, incidental control equipment, including installation cost, was $5,000. The system was designed, installed and put into operation by the electrical engineer of the company, in collaboration with the operating officials at the mine.

The system controls haulage in five mine sections and from three storage tracks; it also controls three substations, five sectional circuit breakers, two signal circuits to the shaft bottom, one signal circuit to the surface and two

Fig. 1—Schematic Diagram of Haulage Layout and Signals



metering circuits. Provisions have been made in the wiring for any necessary future extensions. The order in which the major operating activities are subject to control is as follows:

Main haulage (first).
Gathering haulage (second).
Mine sections (third).
Hoist and tipple (as last resort).
Ventilation and cleaning plant (not controlled).

Because demand integration can be checked during the entire 15-minute period, it is seldom necessary to cut off section loads, much less the surface load. Chief reliance is placed on speeding up or delaying haulage movements to compensate for the fluctuations of other loads. The fact that these other loads are seldom interrupted, however, does not mean that their inclusion in the control system is unnecessary, since a single period of towering peaks in a month may spell the difference between moderate and high power costs. Incidentally, as there is no necessity or incentive for reducing the demand during the night shift, control in that period is confined to limiting the trip size.

Central location of the control station makes future moves during the life of the mine unnecessary. The control board consists of a steel desk skirted on three sides by vertical steel panels. An impulse-operated watt-hour demand meter and an electric clock for timekeeping are mounted on the control panel. Extending horizontally across the central and part way across the side panels is a miniature track layout showing main gathering tracks and the main line to the hoisting shaft. Indicating lamps and control switches are spotted on this track layout to correspond to the points each actually controls. Remaining space on the two side panels is taken up by control switches and indicating lamps for the various sidetracks, sectional circuit breakers, motor-generator sets and miscellaneous signals. The desk, built in accordance with coal-company specifications by Westinghouse, is so arranged that it can easily be altered to conform with any changes in mine plans.

The watt-hour demand meter is equipped with a special indicator, developed by the coal company's electrical engineer, which permits the relation between integrated demand and time, or the rate of integration, to be checked instantaneously. The dispatcher, therefore, can determine at a glance how much load must be removed from or added to the system to arrive at a given demand value at the end of the 15-minute integration period. Conversely, he is shown how much time is available for bringing the integration to the desired point.

A 3-in.-diameter wheel carrying a looped band scale on its ½-in.-wide periphery and mounted on the thumbscrew of the pen-resetting mechanism comprises the special indicator. Attachment is made through a sleeve at the end of the wheel shaft, which fits snugly over the thumbscrew. A stationary pointer gives the reading on the revolving wheel scale drawn on a strip of white drawing paper which is glued into a loop. The effective length of this strip is equal to the periphery of the wheel. As shown in Fig. 2, the right-hand margin of the strip is marked off for time and the left-hand margin for the average kilowatt demand to which the load is being regulated. A number of scales of this kind are available, each corresponding to the division value on the integrated demand chart, as 0 to 0.46, 0 to 0.47, and up. Told the production expected from the shift, the dispatcher uses the scale which will give him the correct integrating data for the demand allowable for that particular tonnage.

A hand phone, mounted on the left panel of the control board, is connected through two switches so that direct connection can be established between the dispatcher and the power house or between the dispatcher and any mine section. Direct connection can be made also between various sections of the mine, thereby minimizing interference. If a call made from one section is unanswered, the dispatcher takes the message and relays it at the first opportunity, allowing the caller to return to his duties.

Fig. 1 shows the locations of block signals. The two parallel main-line roads are divided into three blocks each to avoid crowding trips on heavy grades. At present, these straightaway blocks are seldom used, except in an emergency, for, once started by the dispatcher, a main-line trip generally is allowed to proceed uninterrupted to its destination, because of the grades. If, while trips are en route, demand shows signs of approaching a penalty level, the dispatcher prefers to cut off a mine section or two for a brief period.

Each track-block entrance has one red and one green indicating lamp and also a lamp control switch so connected to duplicate lamps and a control switch on the control board that the man at either end can always determine if the system is in operating condition. These lamps and switches not only enable the dispatcher to hold or give the right-of-way to a haulage unit at a block entrance but also facilitate communication between the dispatcher and the haulage crews by a system of light flashes.

The "stop" signal is indicated when red and green lights burn dimly together. When a haulage man desires to communicate with the dispatcher from a sidetrack signal station, he closes the control switch momentarily. This actuates a relay on the control board, setting a red light at the signal station and on the control board. When the dispatcher is ready to receive the caller's signal, he operates the corresponding control switch on his board and resets the red lamp to "neutral," or dim. While the control switch on the board is held in neutral, the control switch at

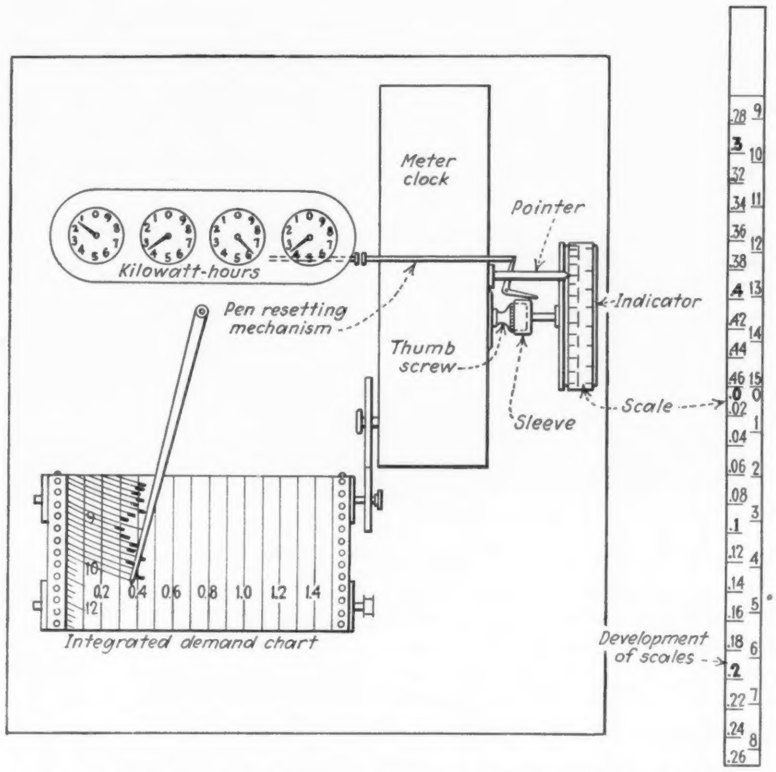


Fig. 2—Integration Rate Indicator Mounted on Recording Demand Meter

the other end can be operated to transmit short and long flashes of the red lights. The dispatcher can reply by transmitting flashes of the green light.

Having the attention of the dispatcher, the crew must first be identified. As the particular trip may include cars of coal, boney and rock, the caller must follow a strict sequence in announcing the makeup. One long red flash indicates ten cars and one short red flash indicates one car. The dispatcher transmits one green flash when signals are received and understood, two green flashes when the last signal is to be repeated, three green flashes when he wants the caller to go to the nearest telephone. Finally, he sets the green lamp to give the crew a clear track and as an indication to proceed. Main-haulage crews signal the number of cars available on the sidetrack, as a check for the dispatcher's records. The dispatcher indicates to them the number of cars to be taken and the destination.

A schematic wiring diagram of the track-signal circuit is shown in Fig. 3. The circuit is energized by the trolley wire, using the rail as a ground, and is controlled by one special wire, the polarity of which can be changed from positive to negative, or vice versa. *A* is a single-pole, spring-reset, normally open-type control switch operated by a cord which can be reached by the motorman without leaving his locomotive. *B* and *C* are two 50-watt signal lamps mounted in a cast-iron signal box. The lamp behind the red lens is rated at 300 volts, and that behind the green lens at 275 volts. *D* and *E* are two 275-volt switchboard-type indicating lamps. *F* is a single-pole relay with front and back contacts. *G* is a spring-reset control switch, so arranged that contact *d-e* is normally closed; contact *f-g* closes when the control switch is operated in one direction but does not open until the control switch is operated in the opposite direction. *H* is a 500-ohm resistance tube.

When switch *A* is closed, the control wire is energized to full-line potential and relay *F* closes its front contact, *c-a*. Switch *A* can then be released, but full voltage will be maintained on the control wire through the contact *c-a* of the relay. Under these conditions, lamps *C* and *E* will burn at full brilliancy. This indicates to the dispatcher that the signal station in question is calling, and also shows the caller that the dispatcher is getting the signal.

When ready to receive the signal, the dispatcher operates switch *G* to open contact *d-e*. This opens the circuit of the coil on relay *F* and front contact *c-a* opens. In this position all lamps are dim (neutral), indicating to the caller that the dispatcher is ready to receive his signals, which he sends by holding control switch *A* closed for short or long periods, according to the code. While this switch is closed, the control wire is at full potential; lamps *C* and *E* are burned brightly and lamps *B* and *D* are dark.

After a caller's signal is completed, the dispatcher moves control switch *G* to close contact *f-g*. This establishes a circuit, from ground through resistance *H* and back contact *b-c* of relay *F* to the control line, connecting resistance *H* in paralled with lamps *C* and *E*. The resistance of this parallel circuit, compared to the resistance of lamps *B* and *D*, is so low that the green lamps burn practically bright while the red lamps are practically dark. By holding contact *f-g* closed for short or long periods, the dispatcher can answer the call.

Control wires (No. 14) go out from the dispatcher's station as armored multiple-conductor cables to junction boxes and as open wires from there to destination. The cable is suspended from steel messenger wire.

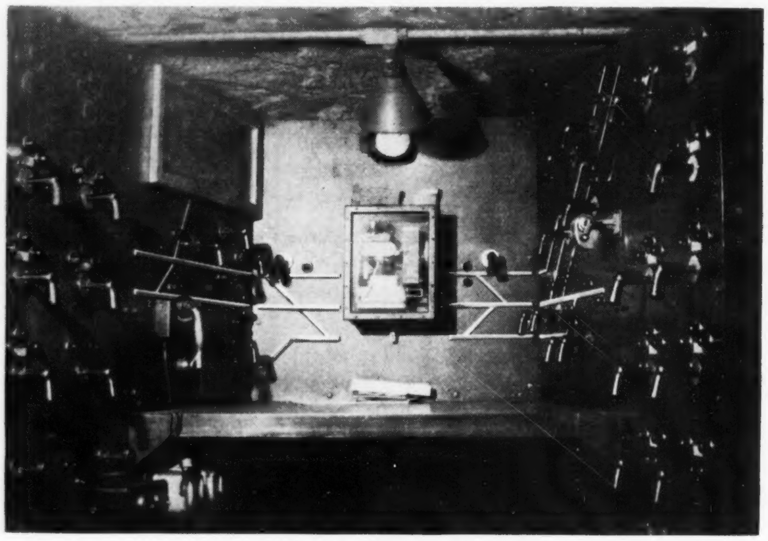
Each section of the mine is protected by an automatic sectionalizing circuit breaker. These can be operated from the dispatcher's control board, on which the position of each breaker is indicated at all times by a red and green lamp. A schematic diagram of this control circuit is given in Fig. 4. *A* is the dispatcher's control switch, which must close at *a* or *b*; B is an indicating relay with a series coil; *C* and *D* are indicating lamps, each with a resistance for burning bright or dim; *E* indicates the reclosing circuit breaker; and *F* shows the overload tripping and automatic reclosing control (for simplicity one contact only is shown).

When circuit breaker *E* is tripped from overload or through the local control switch on it, relay *B* opens and the green indicating lamp burns dim. When the breaker is opened through operation of control switch *A*, the green lamp burns bright, and the breaker will not reclose until the dispatcher reverses the control switch setting. When the circuit breaker is closed, the red indicating lamp burns brightly.

Operation of the motor-generator sets is controlled in much the same way. The position of the d.c. breaker and the a.c. lockout are shown by indicating lamps at the remote-control station.

In addition to customary tipple equipment, preparation facilities include air tables, vibrating screens and a crusher. The cleaning plant is in a separate structure and normally handles about 70 per cent of the mine output. When demand leans toward the smaller sizes, an additional 20 per cent may be crushed and sent to the air tables. When this is done, the normal preparation load is increased 100 kw. by the crusher and 100 kw. by a spare air table placed in operation to handle this excess tonnage. Obviously, the preparation plant cannot be stopped willy-nilly to reduce power demands. However, if the dispatcher knows when the crusher and spare table are to go in service, he can synchronize their starting with the beginning of a demand period, as indicated by the watthour meter before him, and thereby avoid an inordinately high demand.

An "average-load" breakdown of purchased power for the entire operation—at a per-day-shift rate of 2,000



Control Desk in Dispatching Station

Table II—Normal "Average-Load" Breakdown of Purchased Power

Outside Load (not controlled)	Kw.	
Cleaning plant and tipple	750	
Ventilation	150	
Hoisting	250	
Lighting, shop laboratory, line and transmission losses	50	
Total outside load		1,200 kw.
Inside Load (controlled)		
For working sections, including main-line haulage		480 kw.
Total load, inside and outside		1,680 kw.

tons above ground and 1,000 tons below ground—is shown in Table II. "Average load" is the mean kilowatt load for a shift, taken from the chart of a graphic wattmeter. The figures set forth are predicated on the assumption that the surface load is regular, but not controlled, and that the underground load is closely controlled.

Without relentless attention to load integration, the fluctuating nature of the underground load would cause the power situation to go completely out of hand. For example, a section might be working four to six conveyors, each with a connected load of 20 hp.; a mining machine at 50 hp. and two gathering locomotives at 60 hp. each—not to mention the possibility of a main-line locomotive at 170 to 340 hp. Conceivably the highest integrated demand for a 15-minute metering period might then be three times the prorated, or average, load per working section of 120 kw. It is quite possible, too, that during some one metering period in the month each of the four sections might have approximately the same high demand value.

In that event, underground demand would be 1,440 kw., and plant demand, including a surface load of 1,200 kw., would be 2,640 kw. Even with the steam-driven generator loaded to its capacity of 340 kw., purchased power demand would 2,300 kw. This shows why the mine had purchased-power demands close to this figure, even after the steam-driven generator was placed in service; January and February, 1932 (see Fig. 5), for examples. November, 1931, is another example, but in that month the tonnage was 20 per cent above the norm used as the basis for the assumed "uncontrolled" load. The drop from these actual "uncontrolled" demands of 2,300 kw. to 1,640 kw. under close control indicates a possible demand saving of 660 kw.

Fortunately, the diversity of operation permits, especially when loads are controlled, a 15-minute demand value which is considerably lower than the sum of individual unit loads, as in April, 1933, when the mine operated at a reduced rate and only three mine sections were worked. On day shifts, with the cleaning plant in operation, the dispatcher limited underground demand to 350 kw. For the same mine output on other day shifts, with hoist and tipple operating but with the cleaning plant down, a mine demand of 560 kw. was reached. On these other day shifts there was no necessity for load control, except in scheduling haulage, because the additional mine demand was far less than the demand normally established by the cleaning plant. For the same mine output on night shifts, no control attempted other than the limiting of trip size, the underground demand rose to 750 kw. These three demands, differing in steps of 200 kw., plainly show the result of each gradation of load control.

With this flexible method of control, the dispatcher can adjust loads over a wide field in immediate response to surges or slumps in the demand integration rate. Without the gage of allowable demand provided by the indicator disk on the demand meter, such flexibility would be unavailable. Some idea of this flexibility can be gathered from the fact that the haulage load from sidetracks may range from zero to 800 kw. for three to five minutes, depending upon the benefit to cost of maintaining any intervening value. Yet another merit of this system is that it shows positively what can or cannot be done without sacrifice of power cost.

It is the duty of the dispatcher to investigate practices that threaten to raise demand above the allowable value and, having found the facts, to inform the officials concerned. Gradual development of the system toward a fine point of efficiency has required study and experience on the part of the dispatcher and mine officials. The dispatcher, incidentally, has thorough knowledge of the underground workings and conditions, having served as assistant foreman and in various other capacities. In addition, he has been coached by the electrical engineer in the broad theories of electricity.

The effect of load regulation on purchased-power requirements during 1931-1932 is broadly told by the graphs in Fig. 5. These map the progress made in power savings in terms of 15-minute maximum demand for the entire plant, consumption below ground in kilowatt-hours per ton and monthly energy costs. The power-cost and production graphs are constructed on a percentage basis, 100 per cent indicating normal, as of September, 1932. For approximately the same tonnage and maximum demand, April and November, 1931, show a difference of 1.55 kw.-hr. per ton. The increase in November is normal in that it represents the additional power required for hauling over heavier grades. A further increase in tonnage from basic workings occurred in April, 1932, which is reflected by a rise in kilowatt-hour consumption in the month following, when the permanent dispatching system was first placed in service.

After the dispatcher and haulage crews became more familiar with the system, these normal increases were soon more than offset by over-all reductions in consumption. A decrease of 1.75 kw.-hr. per ton was recorded in July, 1932, from May though the tonnage produced was less, and in November, 1932, a saving of 2.1 kw.-hr. per ton was made over June, 1932, the output being practically the same in both months. These economies alone are sufficient basis for the belief that the future consumption per ton will compare favorably with unit consumption

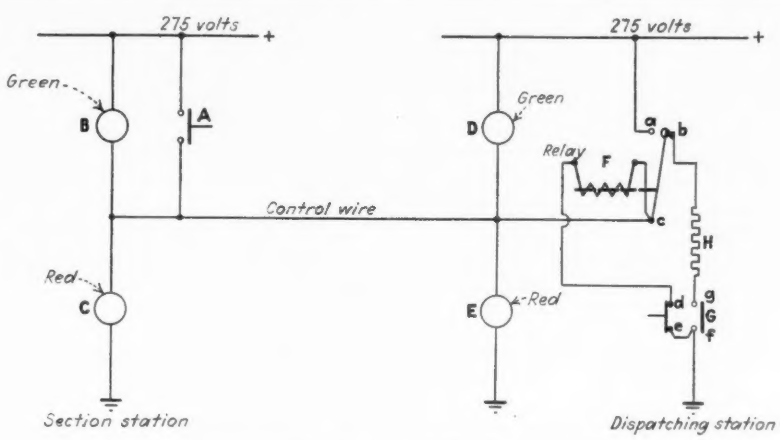


Fig. 3—Schematic Wiring Diagram of Track Signal Control Circuit

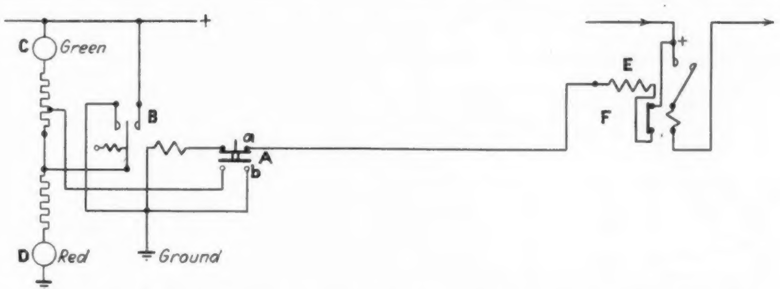


Fig. 4—Diagram of Control Circuit for Automatic Reclosing Circuit Breaker

in the months prior to May, 1931, though there has since been a normal increase of 2 to 3 kw.-hr. per ton, due to mining by conveyors and to hauling a greater proportion of the tonnage over heavier grades.

Maximum demand has been reduced to such an extent that in months of greatly reduced consumption the load factor has compared favorably with that established when monthly energy consumption was 30 to 40 per cent higher. This point is important because the unit cost of energy is based on load factor. In January, 1931, when the load factor was 30 per cent, the energy charge was 1.1c. per kilowatt-hour, whereas in October, 1932, for a considerably lower tonnage, but with a load factor of 41 per cent, the charge was only 0.838c. per kilowatt-hour. A load factor of 55 per cent would result in an energy charge of 0.7c. per kilowatt-hour. This low cost has been approached by increasing load factors to near 50 per cent in the early months of 1933, when tonnage improved.

Besides bringing the energy charge within low unit cost range, dispatching has achieved a material saving in the primary or demand charge. For January, 1931, the tonnage was but 95 per cent of normal, yet the demand was 2,400 kw. and the power cost correspondingly high. At that time practically all the tonnage was coming from sections fairly close to the shaft bottom and having favorable or easy grades. Between January and May, 1932, a minor slump appears in the demand graph. It was during this period that the first attempt was made to regulate load by spacing trips. During the year 1930, demands varied generally from 2,350 to 2,400 kw., with a high of 2,560 kw.

In June, 1931, the 250-kw. steam-driven generator was placed in service to cut down purchased-power peaks. In July, 1931, a temporary dispatching-signal system was installed. These two changes caused an immediate drop in demand, which was sustained with minor fluctuations until September. However, the control of loads by the improvised dispatching system was so tedious a procedure that the system was abandoned in September, 1931. All credit for demand reduction was given to the generator.

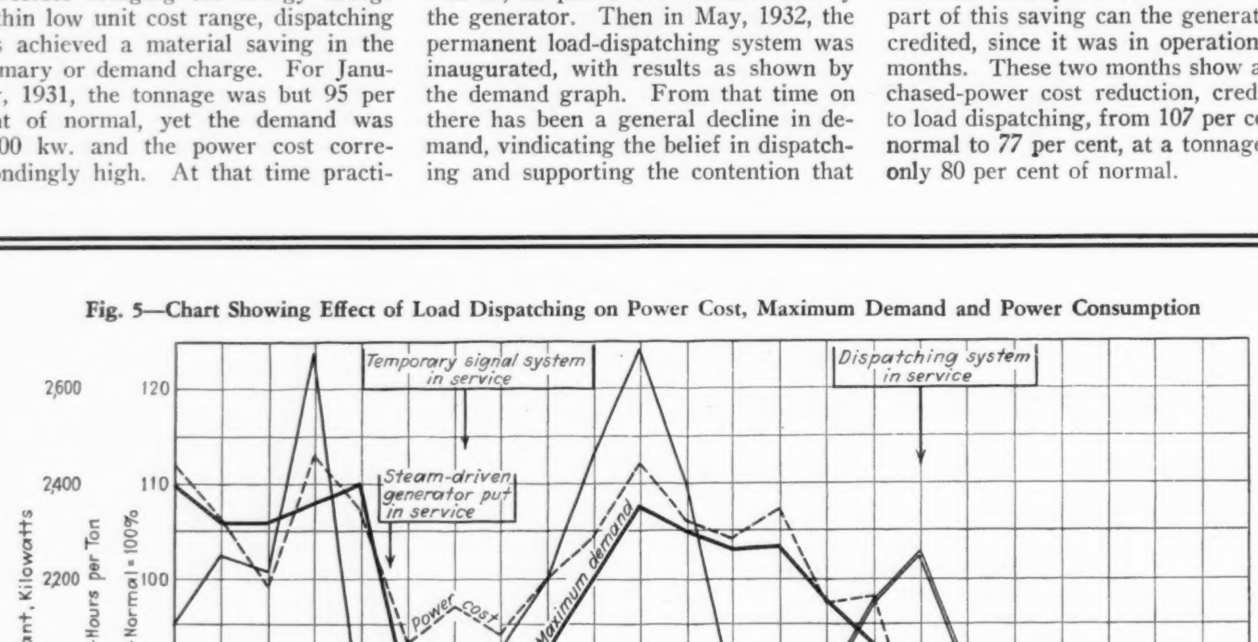
Yet from September, 1931, to the end of April, 1932, demand spiraled upward almost to the highs established in earlier months, despite the relief afforded by the generator. Then in May, 1932, the permanent load-dispatching system was inaugurated, with results as shown by the demand graph. From that time on there has been a general decline in demand, vindicating the belief in dispatching and supporting the contention that the steam-driven generator was only a secondary, though helpful, aid.

That tonnage declined at the same rate had small part in this improvement, for the decline was more the effect of idle days than of curtailment of operation on working days. For example, the July, 1932, tonnage was only 47 per cent of normal and yet the demand was less than 50 kw. below that for October, 1932, when production was 79 per cent.

With the degree of regulation thus far achieved the control system should limit variation in demand to not more than 100 kw. between any two months of normal operation. The only variation in kilowatt-hour consumption should be that represented by changed conditions, feeder losses and variations in pumping load. Pumping in this mine at 100 per cent production accounts for an average of 10 per cent of energy consumed below ground.

A comparison of results in October with those of February, 1932, when tonnages were equal, gives full force to the demand saving realized thus far. It amounts exactly to 464 kw. For no part of this saving can the generator be credited, since it was in operation both months. These two months show a purchased-power cost reduction, creditable to load dispatching, from 107 per cent of normal to 77 per cent, at a tonnage rate only 80 per cent of normal.

Fig. 5—Chart Showing Effect of Load Dispatching on Power Cost, Maximum Demand and Power Consumption



A.I.M.E.

+ Delves in Many Fields

WITH studies of roof control, health and safety, coal classification and mining education, the American Institute of Mining and Metallurgical Engineers and its Coal Division held an interesting and successful congress—its 143d meeting—at the Engineering Societies Building, New York City, Feb. 19 to 22. Accounts of the papers and discussion on subsidence and roof control will appear on p. 103, and information relative to the coal classification program on pp. 106 and 107.

At the Wednesday morning meeting, with H. F. McCullough, engineering manager, Philadelphia & Reading Coal & Iron Co., Pottsville, Pa., in the chair, H. G. Turner, director, coal research, Pennsylvania State College, discussed "A New Use for Pennsylvania Anthracite"—namely, the filtration of domestic water supplies, sewage and boiler water. The fitness of anthractite for this purpose was described by Dr. Turner at the Third Pennsylvania Mineral Industries Conference, held at Pennsylvania State College, Nov. 10-11. Dr. Turner's remarks at that meeting, which covered much the same ground, may be found on pp. 418-419 in the issue of *Coal Age* of December, 1933.

Expense incurred in preparing to raise, float and scrub sand in filtration basins, said L. H. Enslow, editor, *Water Works and Sewerage,* involved the use of pumps of large capacity, because the sand was so heavy and the incrusted impurities on it difficult to remove. Much of the cost for such pumps and for the power to operate them would be greatly reduced if a lighter material, anthracite, were used, especially a material which, like anthracite, could be rapidly freed of adhering impurities. Strange to say, Messrs. Fuertes and Wilson had used anthracite at Dallas, Texas, and Denver, Colo., anticipating Dr. Turner. P. S. Wilson, consulting engineer, said that the coal used at Denver was anthracite dredged from the Susquehanna River, by which stream it had been washed and sized. Dr. Turner remarked that coal that had been rolled in the river made a closer bed, which retarded filtration, soon clogged up and was a poorer filtration medium than anthracite of less uniform cross-section.

Reports of committees on methods of valuing coal properties and on evaluation of coal for blast-furnace coke were presented by J. B. Dilworth, consulting mining engineer; Edward V. D'Invilliers Engineering Co., and R. H. Sweetser, consulting engineer, respectively, chairmen of the committees. Mr. Sweetser's report declared that (1) samples for analysis of coal should be taken where it is weighed for sale purposes, (2) the base for Pittsburgh seam coal shall be a total ash content of 9.5 per cent at 221 deg. F., only 5 per cent of the coal content being 1.55 specific-gravity material. Further, the base shall be a coal having 3.2 per cent moisture as determined at 212 deg. F.

At the luncheon of the Coal Division, Feb. 19, E. W. Parker, acting director of the Anthracite Institute, declared that the institute has examined 150 devices and approved 52. It has developed seven devices of its own. Freight rates are so high, declared C. B. Huntress, executive secretary, National Coal Association, as to hamper the coal industry and thus cripple the railroads, which would profit by a larger traffic in coal. Washington is erecting hydroelectric projects that no one thought worthy of development by private capital and is thus displacing coal, which employs more men, and supplies the needs of the public at less cost than electricity when the expense of plant construction is considered. Eli T. Conner, chairman, Coal Division, presided.

At the Tuesday afternoon health and safety meeting, over which J. T. Ryan, general manager, Mine Safety Appliances Co., presided, leather gloves were discussed in connection with the paper by R. D. Parker, mine superintendent, International Nickel Co. Workmen at the Frood mine, of his company, are required to use unlined leather gloves, said Mr. Parker, though whether these be gauntlets or short gloves is left to the wearer. Ore cuts canvas gloves, and even leather gloves must be of reputable make and good materal.

For mine workers, the right kind of glove has yet to be found, said Eugene McAuliffe, president, Union Pacific Coal Co. He desired to find suitable hand protection, for hand injuries caused his company its largest compensation loss. Compensation paid for eye injuries at his mines, said Mr. McAuliffe, cost in eight years $27,521.63, or $3,440.20 per year. In that time there were 127 eye injuries, an average of 16 per year. Last year, by the introduction of goggles, the number of eye accidents had been reduced to four and the compensation cost to $1,960.49. On April 24 of last year, a man who, four days before had been examined for protective goggles, received from a small piece of steel what appeared to be a trivial accident, but the splinter by which it was occasioned had lodged in the muscles back of the optic and later caused an infection which made the removal of the eye necessary. The other three accidents occurred earlier than the one narrated, after which, with the completion of the sight-protective program, no further accident to eyesight occurred.

Of 1,742 men examined by a skilled oculist, 436, or only 25 per cent, had

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Karl Eilers, vice-president; metallurgical engineer, New York, N. Y.

Henry A. Buehler, director; state geologist, Rolla, Mo.

Charles B. Murray, director; Crowell & Murray, Inc., Cleveland Ohio.

Brent N. Rickard, director; manager, El Paso Smelting Works, El Paso, Texas.

George B. Waterhouse, director; professor of metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

William Wraith, director; assistant research engineer, Anaconda Copper Mining Co., Anaconda, Mont.

normal, 20/20, vision without glasses; 1,306, or 75 per cent, had defective vision; 593 of these, or 28.3 per cent of all men examined, had major defects. Of the 593 men, 113, or 6.48 per cent of the entire force, had eyesight in very bad condition, some which dated to birth and some to disease and accidents, either occurring in boyhood or in maturer years outside the mining industry. Other defects were chargeable to accidents in or about the mine.

Of these, seven had one eye removed; some were wearing an artificial eye. One of the seven, unfortunately, lost an eye while the survey was being made. Twenty men were either totally blind in one eye or had light perception and projection only in one optic. Seventy-two men had poor vision in one or both eyes which glasses could not correct. Fourteen had a progressive eye disease, which will, in all probability, grow worse. One man's vision was so defective that he could not count the number of fingers held before his eyes at a distance of 2 ft.

With mechanical operation, side vision is so important that side screens were not provided in the goggles supplied. Only the goggles of machine-shop men were so equipped. Because of the depression, examination and glasses were furnished free to all men; replacements are to be made by the employees at their own cost. The average cost per employee, including examination and grinding for correction, where necessary, was $3.21 per pair. Men with impaired vision were placed in jobs suited to their infirmity.

At the meeting of the Mining Methods Section in the afternoon of Feb. 22, under the chairmanship of Lucien Eaton, consulting engineer, A. S. Richardson, ventilation engineer, Anaconda Copper Mining Co., presented a paper on experimental air conditioning at Butte mines, prepared by W. B. Daly, manager of mines, and himself. In the Butte mines, rock temperatures as high as 120 deg. F. have been noted, but the temperature at the surface in the winter is often—20 deg. F. and the wet-bulb temperature in the summer seldom exceeds 60 deg. F. In July and August, so little moisture is in the air that the point at which dew would be deposited drops below the freezing point. The company has made progress with the operation of a pilot testing plant in which a closed circuit of calcium chloride brine in a pipe, which has that part insulated in which the cooled brine is taken into the mine, provides, underground, the means of cooling pipe coils on which water is sprayed. The brine is cooled in a cooling tower on the surface and, becoming heated by the sprays, travels back up to the surface for recooling.

Revision of curricula offered by engineering schools to enable graduates to better meet the problems of their chosen profession was a major topic at the two sessions of the Mineral Industry Education Division on Feb. 18 and 20, with C. H. Fulton, director, and C. L. Dake, professor of geology, Missouri School of Mines and Metallurgy, and H. T. Mann, associate professor of petroleum engineering, Massachusetts Institute of Technology, presenting papers on the subject.

Officers of Coal Division

Eli T. Conner, chairman; consulting engineer, Scranton, Pa.

John T. Ryan, vice-chairman; general manager, Mine Safety Appliances Co., Pittsburgh, Pa.

Clarence E. Abbott, executive committeeman; vice-president, Tennessee Coal, Iron & R.R. Co., Birmingham, Ala.

Gilbert H. Cady, executive committeeman; senior geologist, Illinois State Geological Survey, Urbana, Ill.

Harry E. Nold, executive committeeman; professor, mining engineering, Ohio State University, Columbus, Ohio.

Charles E. Lawall, executive committeeman; director, School of Mines, West Virginia University, Morgantown, W. Va.

William B. Plank, head, department of mining and metallurgy, Lafayette University, presented a statistical study of enrollment, courses and degrees, and the employment situation of recent graduates from the mineral-industry schools of the United States and Canada. Enrollment in such schools, said Professor Plank, has been decreasing since 1930-31, but at a lesser rate than other engineering enrollments. Approximately 80 per cent of the 1933 graduates are employed or remain in graduate schools.

Applied psychology in relation to bonus payments was the theme of an address by Eugene McAuliffe at the Feb. 20 session. When machines were substituted for hand-loading at Union Pacific mines several years ago, there was no audible protest, but production was restricted in many inconspicuous ways. Men assigned to machines had for the most part been working on the task or tonnage basis, and with the shift to the hourly basis, the incentive to diligence largely disappeared. Time studies showed an inadequate production per machine-shift, and while output increased in course of these studies, it immediately fell off when this additional supervision ceased. As a remedy, a bonus system, providing added payments for additional production, but no penalty for low output, was adopted.

Although this plan was based on applied psychology, the management made the initial mistake of setting the distribution of the value of the increase in output at 25 per cent to the miner and 75 per cent to the company. A proposal for a 50-50 split usually will receive consideration, whereas 75 per cent to the proposer is almost sure to be refused. As a result, the workmen, still saying nothing, went on just as before. A 50-50 split was then established, and though a substantial gain in output was realized, results still were disappointing, due primarily to the fact that bonus payments were not made separately and therefore were regarded merely as wages. This situation was cured by keeping bonus earnings entirely separate, a special check of distinctive color, with the words "For meritorious service" printed across the face, being used in making payments. In substance, bonus money is now treated, as originally intended, as a personal reward for extra services rendered.

"The bonus system, when once under way, not only served to lift the daily task of operating a loading machine above the level of a grind but it created an incentive to achievement and gave the men something to think about. For the first time, an interest was shown in the number of cars loaded as the day progressed. Better care is now taken of machinery used, for temporary stoppages interfere with an adequate production." Also, crews show a disposition to insist on laggards doing their part, and individuals, with the approval of the foreman, have voluntarily traded places, with the result that crews have become more nearly homogeneous units, and therefore most efficient. Results obtained through the bonus include an increase of 36 per cent in output per man-shift.

Production, said Mr. McAuliffe, comes principally from shaker conveyors equipped with duckbills, shoveling constituting only about 5 per cent of the labor required. Loading units are moved about every two weeks. This moving time, which is included in the bonus plan, has been reduced 50 per cent in consequence.

To force adoption of improved methods is bad psychology. No deductions are made for subnormal work, such dereliction being a matter for discipline. Because of difficult places and disabilities, only about 56 per cent of the men earn bonuses.

T. T. Read, Vinton professor of mining, Columbia University, was elected chairman of the division for the coming year, and Melville F. Coolbaugh, Colorado School of Mines, was chosen vice-chairman. Members of the executive committee, three-year terms, are: A. C. Callen, head, mining engineering department, University of Illinois; George B. Waterhouse, professor of metallurgy, Massachusetts Institute of Technology; C. M. Young, professor of mining engineering, University of Kansas; and Jay A. Carpenter, professor of mining, Mackay School of Mines, University of Nevada.

UNION GAINS

+ Establish Collective Bargaining

In Almost All Bituminous Fields

ACCOMPANYING an analysis of union gains in 1933, *Coal Age* published in the February issue (pp. 66-67) a tabular summary of inside and outside day scales included in agreements covering most of the bituminous fields of the country. Supplementing last month's presentation, this article includes inside and outside day rates for the Tennessee-Georgia, southern Tennessee and western Kentucky fields, completing the list of major agreements with the exception of the Brazil Block field of Indiana and the temporary adjustment in Vandenburg and Warrick counties in the same state. In addition, tonnage, yardage and deadwork rates for the various fields, as far as available, are given in a separate supplement folded into this issue.

Recapitulation indicates the adoption of general agreements in all the major bituminous fields with the exception of Alabama and the Dakotas. The western Kentucky agreement, however, has been signed only by Ohio and Muhlenberg county operators, according to reports. Western Pennsylvania captive mines, following the action of the H. C. Frick Coke Co. and other coal-producing subsidiaries of the United States Steel Corporation, started to put their signatures on special agreements in February to apply to those mines where officials of the United Mine Workers were chosen as representatives of the majority of the men at special elections held by the National Labor Board.

As the majority of the agreements in fields previously non-union were an outgrowth of the passage of the National Industrial Recovery Act and the subsequent adoption of the bituminous code, which extends to April 1, 1934, and thereafter in the absence of action by the President, they expire on March 31, 1934. This same applies to a number of prior agreements, as well as to agreements in fields where relations were temporarily severed but resumed after the adoption of the code. The Arkansas-Oklahoma, Illinois, Indiana and Iowa (outside Wayne and Appanoose counties) agreements, however, expire in 1935. Expiration dates of the various agreements, together with the operator groups signatory thereto, are as follows:

March 31, 1934—Southern Colorado-New Mexico, producers in the region, including the Colorado Fuel & Iron Co. (separate agreement); Appanoose and Wayne counties (Iowa), Appanoose and Wayne Counties Coal Operators' Association; Kansas-Missouri (Cherokee and Crawford counties, Kansas; Barton County, Missouri), Southwestern Interstate Coal Operators' Association; Kentucky—Big Sandy-Elkhorn, Big Sandy-Elkhorn Coal Operators' Association; Hazard, Hazard Coal Operators' Association; Harlan, Harlan County Coal Operators' Association; western Kentucky, western Kentucky producers; Kentucky-Tennessee—Southern Appalachian, Southern Appalachian Coal Operators' Association; Michigan, operators in the State.

March 31, 1934—Ray and Clay counties (Missouri), Ray and Clay County Coal Operators' Association; Montana, Montana Coal Operators' Association; Ohio—Hocking, Massillon, Coshocton and eastern Ohio agreements, Ohio Coal Control Association; Pennsylvania — central, Eastern Bituminous Coal Association; Somerset County, Somerset County Coal Operators' Association; western, Coal Control Association of Western Pennsylvania and the Coal Operators' Association of the Thick Vein Freeport Seam of Pennsylvania; southern Tennessee, Southern Tennessee Coal Producers' Association; Tennessee-Georgia, Tennessee-Georgia Coal Producers' Association; Utah, Utah coal operators; Virginia, Association of Virginia Operators; Washington, Coal Producers' Association of Washington.

March 31, 1934—West Virginia—Greenbrier, Greenbrier Smokeless Coal Operators' Association; Kanawha, Kanawha Coal Operators' Association; Logan, Logan Coal Operators' Association; New River, New River Coal Operators' Association; Pocahontas-Tug River, Pocahontas Operators' Association; Williamson, Operators' Association of the Williamson Field; Winding Gulf, Winding Gulf Operators' Association; northern West Virginia, Northern West Virginia Coal Association; northern West Virginia Panhandle, Northern Panhandle of West Virginia Coal Operators' Association; West Virginia - Maryland — Georges Creek-Upper Potomac field, Georges Creek and Upper Potomac Coal Control Association.

April 30, 1934—Southern Wyoming, Southern Wyoming Coal Operators' Association and the Union Pacific Coal Co. (separate agreement); northern Wyoming, Hotchkiss, Sheridan and Sheridan-Wyoming coal companies.

Aug. 31, 1934—Northern Colorado, Northern Colorado Coal Producers' Association.

March 31, 1935—Arkansas - Oklahoma, Arkansas-Oklahoma Coal Operators' Association and others; Illinois (U.M.W. and P.M.A. agreements), Illinois Coal Operators' Association and the Coal Producers' Association of Illinois, respectively; Indiana, Indiana Coal Operators' Association and the Indiana Coal Producers' Association (strip mines); Iowa (outside Appanoose and Wayne counties), Iowa Coal Operators' Association.

Paralleling the terms of the bituminous code, which called for a conference of employers, employees and representatives of the NRA on Jan. 5, 1934, to determine what, if any, changes were necessary in wages, hours and differentials or other code requirements in the light of preliminary experience, concurrent conferences on new contracts were provided for in Appalachian agreements, as well as in a few other agreements signed as a result of the code. Postponements of the NRA conference were accompanied by corresponding postponements of the Appalachian conference to Feb. 28, when organization of the joint negotiating machinery was begun in Washington.

The check-off, usually with a protec-

tive clause, has been included in one form or another in the majority of the new agreements and in all the old. Agreements containing the check-off are as follows: Arkansas-Oklahoma, northern Colorado, southern Colorado (including the Colorado Fuel & Iron agreement), Kansas-Missouri, Illinois (U.M.W. and P.M.A.), Indiana, Appanoose and Wayne counties, other Iowa, Big Sandy-Elkhorn, Hazard, Harlan, southern Appalachian, western Kentucky, Michigan, Ray and Clay counties (Missouri), Montana, Hocking, Coshocton, Massillon, eastern Ohio, central Pennsylvania, Somerset County (Pennsylvania), western Pennsylvania, Utah, Virginia, Washington, Greenbrier, Kanawha, Logan, New River, Pocahontas-Tug River, Williamson, Winding Gulf, northern West Virginia, northern West Virginia Panhandle, southern Wyoming (including Union Pacific Coal Co. agreement) and northern Wyoming.

No provisions for the check-off were included in the southern Tennessee, Tennessee-Georgia and Georges Creek-Upper Potomac wage agreements.

Provisions for the adjustment of disputes fall into two general classes. In a number of regions, notably those where agreements were in effect prior to the adoption of the bituminous code, the usual procedure calls for conferences between the mine foreman and the miner, between the mine foreman or superintendent and the pit committee, and the management and a representative of the union district, usually the president. Thereafter, the dispute may go to arbitrators or to the operators' commissioner and district officials, and afterward to a joint executive committee or adjustment board, followed by an umpire or arbitrators. Michigan, northern Colorado and Washington also make provisions for referring disputes which cannot be settled by recourse to the usual procedure to the appropriate divisional labor board set up under the terms of the bituminous code.

In the region covered by the Appalachian agreement (Ohio, Pennsylvania, West Virginia, Maryland, eastern Kentucky, Virginia, Tennessee and Georgia), the procedure calls for conferences between the management and the miners, and between the management and the mine committee, after which the dispute is referred to a board of four, two selected by the operators and two by the miners. In case the board fails to agree, the matter is referred to an umpire selected by the board or, in case the board fails to agree, by the NRA Administrator. No consideration of disputes is permitted as long as the mine is shut down in violation of the contract.

Penalties are provided in a number of agreements for strikes or lockouts in violation of their terms, including the following: Arkansas-Oklahoma, northern Colorado, southern Colorado-New Mexico, Illinois, Indiana, Iowa (other than Wayne and Appanoose counties), Kansas - Missouri, Big Sandy-Elkhorn, western Kentucky, Ray and Clay counties (Missouri), Montana, eastern Ohio, western Pennsylvania, Washington, northern West Virginia and the northern West Virginia Panhandle.

Hourly Rates for Inside Labor Included in the Tennessee-Georgia, Southern Tennessee and Western Kentucky Agreements.

(Union districts corresponding to the various fields are shown in parentheses)

Classification	Tennessee-Georgia* (19), Cents	Southern Tennessee (19), Cents	Western Kentucky† (23), Cents
Basic scale‡	**42½**	**48**	**50**
Bonders	42½	48	50
Bratticemen	42½	48	50
Helpers	36¼	44½	...
Cagers	43½	49	...
Helpers	...	44½	...
Car builders	42½	48	...
Car repairmen	...	44½	...
Coal loaders, day work	...	...	50
Couplers	36¼	...	...
Crew helpers	...	45	...
Doodlers	...	38	...
Drillers, coal	...	...	50
Helpers	...	...	47
Rock	...	48	52
Helpers	...	44½	47
Drivers, one mule	36¼	44½	50
Each additional mule	2	...	2
Engineers, hoist	36¼	...	...
Flaggers	...	32½	30
Greasers	36¼	44½	30
Loading-machine operators	...	...	56¼
Helpers	...	...	50
Machine runners	43½	49	56¼
Helpers	42½	48	50
Miners, taken from face	42½	48	47
Motormen	43½	49	52
Muckers	36¼	38	...
Pipemen	36¼	44½	47
Helpers	...	38	...
Pit-car-loader operators	...	...	50
Prop setters	...	...	47
Pumpmen	36¼	44½	47
Rockmen	42½	...	...
Helpers	36¼	...	...
Rollermen	36¼	...	...
Slate pickers	...	44½	...
Spraggers	36¼	44½	...
Switchthrowers	...	32½	30
Trackmen, head	42½	48	...
Helpers	36¼	44½	...
Tracklayers, straight track	...	...	47
Switches	...	...	50
Trappers	36¼	32½	30
Timbermen	42½	48	50
Helpers	36¼	44½	47
Tripriders	36¼	44½	47
Utility men	...	38	...
Water bailers, one mule	...	...	50
Wiremen	42½	48	47
Helpers	...	44½	47
Other inside labor	36¼	35½	47

*Hamilton and Rhea counties, Tennessee; Georgia.
†Ohio and Muhlenberg counties.
‡Basic rates in each case correspond to those established in the bituminous code.

Hourly Rates for Outside Labor Included in the Tennessee-Georgia, Southern Tennessee and Western Kentucky Agreements.

(Union districts corresponding to the various fields are shown in parentheses)

Classification	Tennessee-Georgia* (19), Cents	Southern Tennessee (19), Cents	Western Kentucky† (23), Cents
Basic scale‡	**30**	**35½**	**37½**
Beltmen, washer	...	36	...
Bit sharpeners	37½	38¾	...
Blacksmiths	47	49	...
Helpers	30	38	...
Carpenters	40	...	...
Helpers	30	...	...
Car pushers	...	32½	...
Car repairmen	38	38¾	...
Helpers	30	...	...
Couplers, yard	...	32½	...
Drivers	36¼	...	...
Drum runners	47	49	...
Dumpers, coal	30	38¾	...
Slate	30	32½	...
Engineers, dinkey	37½	...	...
Haulage	41	...	...
Main hoisting	45	...	...
Night	40	...	...
Power-house	47	49	...
Stationary	31¼	...	...
Firemen, power-house	...	41¼	...
Fanmen	30	...	...
Ginmen	...	32½	...
Greasers	30	32½	30
Jig runners	...	38¾	...
Loaders, car	30	...	...
Machinists	50	...	...
Helpers	30	...	...
Motormen, supply or slate	...	42¾	...
Pumpers	31¼	...	...
Sandmen	...	36	30
Sanitary§	18¾	18¾	...
Slate pickers	27	32½	30
Spraggers	30	32½	...
Substation tenders	...	41¼	...
Tablemen, washers	...	36	...
Teamsters	...	36	...
Tipplemen	30	...	...
Trackmen, head	35	...	...
Helpers	30	...	...
Incline	...	38	...
Tripriders	30	...	...
Trimmers	30	38¾	...
Truck drivers	...	36	...
Utility men	...	43	...
Washer labor	30	...	...
Washermen	45	...	...
Helpers	30	...	...
Watchmen	...	36	...
Weighman	41	...	...
Yardmen	30	32½	...
Other outside labor	30	...	...

*Hamilton and Rhea counties, Tennessee; Georgia.
†Ohio and Muhlenberg counties.
‡Basic rates in each case correspond to those established in the bituminous code.
§Old, pensioned or partially disabled employees.

COAL CLASSIFICATION

+ Approaches Conclusion

AT THE meeting of the American Institute of Mining and Metallurgical Engineers held in New York City, Feb. 19 to 22, a classification of coals was presented to the coal classification committee and approved. For convenience, it names each group of coals, but the nomenclature subcommittee will decide finally on that matter. The committee, though admitting it to be tentative and not yet accepted by sponsors, urges it for NRA-code use, lacking any more authoritative standard, for any other classification would inevitably be premature and likely to intrench itself against this more deliberate classification.

A statement of the conclusions was presented by W. A. Selvig, chemist, in a paper by himself, W. H. Ode, and A. C. Fieldner, U. S. Bureau of Mines. The classification appears herewith as Table I. It abandons fuel ratios and rests mainly on fixed-carbon and B.t.u. values. Mineral matter is calculated as 1.1 times ash content.

No dependence can be placed, declared E. Stansfield and K. C. Gilbart, Edmonton (Canada) University, in a paper presented by the former, on tests of the slacking of coal, unless samples are kept in air of standard dryness. Air-drying loss may vary from 12 to 7 per cent if air leaves the oven with 3 and 40 per cent humidity, respectively.

An iron box has been devised with air kept at constant temperature by a fan and carbon-filament electric lamps, with heat emission automatically regulated; moisture content is kept constant by soluble salts; the box has oil-sealed tubes to pass the air needed to maintain barometric pressure. Slacking indexes of one coal were 65.5 with 20 per cent relative humidity in dryer and only 5.1 with 75 per cent humidity. Greater variation was exhibited by a high-rank coal which had a slacking index of 1.7 at 20 per cent humidity and 0.1 at 60 per cent humidity.

In discussion, Mr. Selvig said oxidation during storage, grinding and mixing affected agglutinating tests. G. Theissen, Illinois State Geological Survey, agreed, saying that in one day Illinois coal ground to 100-mesh lost 60 per cent of its agglutinating ability. In grinding, coal in an atmosphere of carbon dioxide retains most of its agglutinating quality.

Anthracite is more reactive than coke, said W. L. Keene, Anthracite Institute, in a paper prepared by himself with H. G. Turner and G. S. Scott; that is, it turns more carbon dioxide to carbon monoxide and starts its reaction at a lower temperature. The authors tested 45 anthracites and 5 cokes, and found average reducing power with anthracite between 900 and 950 deg. C. is 57 per cent, with initial reaction temperature of 572 deg. C. Average reducing power with representative coke, under the same conditions, is 22 per cent with initial reaction temperature of 715 deg. C. Anthracite reactivity varies greatly with change in ash composition and volatile-matter content, with specific gravity a minor influence. Slow-burning anthracites from the eastern middle field have higher initial reaction temperatures and, at 900 and 950 deg. C., a lower reactivity than the free-burning anthracites from the other fields.

At the afternoon session of the committee, Feb. 19, A. C. Callen, University of Illinois, presided. Studies of the mineral matter in coal have been made, using coal separations at 2, and 2.6 gravity, said A. W. Gauger, in a paper prepared by himself, E. P. Barrett and F. J. Williams, Pennsylvania State College. Separations at plus 1.6 gravity contained so much coaly matter as to make identification difficult. Seven samples of coal and three of washery refuse were tested, with results as in Table II. Rationalizing analyses of three coals, ratios of mineral matter to ash for the three samples were 1.25,

Table I—Classification of Coals by Rank

Class*	Group*	Limits of Fixed Carbon or B.t.u., Mineral-Matter-Free Basis	Requisite Physical Properties
I. Anthracitic	1. Meta-anthracite	Dry F.C., 98 per cent or more	
	2. Normal anthracite	Dry F.C., 92 per cent or more and less than 98 per cent	
	3. Semianthracite	Dry F.C., 86 per cent or more and less than 92 per cent	Nonagglutinating†
II. Bituminous	1. Low volatile	Dry F.C., 77 per cent or more and less than 86 per cent	
	2. Medium volatile	Dry F.C., 69 per cent or more and less than 77 per cent	
	3. High volatile A	Dry F.C., less than 69 per cent; and moist B.t.u., 14,000 or more	
	4. High volatile B	Moist B.t.u., 13,000 or more and less than 14,000‡	
	5. High volatile C	Moist B.t.u., 11,000 or more and less than 13,000‡	Either agglutinating or nonweathering
III. Subbituminous	1. Subbituminous A	Moist B.t.u., 11,000 or more and less than 13,000‡	Both weathering and nonagglutinating
	2. Subbituminous B	Moist B.t.u., 9,500 or more and less than 11,000‡	
	3. Subbituminous C	Moist B.t.u., 8,300 or more and less than 9,500‡	
IV. Lignitic	1. Lignite	Moist B.t.u., less than 8,300	Consolidated
	2. Brown coal	Moist B.t.u., less than 8,300	Unconsolidated

*The names given above under "Class" and "Group" are used temporarily, pending recommendations of the Technical Committee on Nomenclature, Sectional Committee on Coal Classification.

†If agglutinating, classify in low-volatile group of the bituminous class.

‡Coals having 69 per cent or more fixed carbon on the dry mineral-matter-free basis to be classified according to fixed carbon, regardless of B.t.u.

1.24 and 1.20, respectively, and ratios of mineral matter minus pyrite to ash minus the Fe_2O_3 equivalent of pyrite were respectively 1.10, 1.14 and 1.18.

In a paper presented later by Gilbert Theissen, similar studies were detailed. He found the Parr formula for mineral matter in coal—1.08 × percentage of ash plus 0.55 times the percentage of sulphur—agrees closely with mineral-matter values as calculated from ash analyses.

Through the first of the authors, G. H. Cady, D. R. Mitchell and K. C. McCabe, Illinois Geological Survey, in the "Preliminary Report on Unit Coal: Specific Gravity Curves of Illinois Coals," described the analytical and spectrographic work done on the No. 6 Illinois coal of Franklin County, in which investigations were made of the coal column in lengths of 1 or 2 in. Feldspars, mica, tourmaline, kaolinite and pyrite vary greatly in percentage. As a rule, if mineral matter is high in kaolinite, it is low in pyrite, and vice versa. He found kaolinite mixed with other clay materials.

Illinois coal showed higher heat values with increased age and depth of cover and also showed decreased heat values at some points of diastrophic disturbance, said Mr. Cady, reading a paper written by himself and O. W. Rees, Illinois Geological Survey. Except in cases of diastrophic disturbance, heat values of unit coal will be found to vary little from the average for any given area unless that area has been subjected to mountain-making disturbances; variant figures need checking.

At the meeting on Feb. 20, L. E. Young, Pittsburgh Coal Co., and T. W. Harris, Jr., E. I. duPont de Nemours & Co., were associate chairmen. An accompanying illustration shows the map which formed the basis of Mr. Turner's remarks. It is based on 218 face samples from 28 mines and additional samples taken at 18 breakers. U. S. Bureau of Mines' standard method of sampling was used in every case. All analyses were corrected to moisture-and-ash-free basis instead of the 1.1 × ash-free correction now proposed.

Where coal has 91.5 per cent fixed carbon, Mr. Turner suggested it be distilled in the end of a tube with a plug of glass wool above it. If tar be present, it will condense as a brown-yellow sublimate, which will not fade as the tube cools. All coals of 91.5 per cent fixed carbon should be rated as anthracite if, in this test, they give no lasting coloration. Forksville coal just began to agglutinate in the tube, suggesting that 86 is the correct lower limit for semi-anthracites.

In some places, it seemed the isovols should align themselves parallel to, rather than across, coal areas, but it seemed best to draw them parallel with those in the bituminous field. Had more analyses been made, the lines would have been, doubtless, extremely irregular. Deeper beds had the lower percentage of volatile matter. Strange to say, volatile matter in beds did not seem to bear relation to the more severe folding, to which the anthracitization of these coals has been ascribed.

Table II—Minerals Found in Heavy- and Medium-Gravity Coal

Mineral	Formula	Samples Containing This Mineral
Pyrite	FeS_2	10
Kaolin minerals	$Al_2O_3.2SiO_2.xH_2O$	10
Chlorites:		
Prochlorite	$2FeO.2MgO.Al_2O_3.2SiO_2.2H_2O$	10
Penninite	$5(MgFe)O.Al_2O_3.3SiO_2$	3
Muscovite	$KNaO.3Al_2O_3.6SiO_2.2H_2O$	10
Calcite	$CaCO_3$	9
Quartz	SiO_2	10
Diaspore	$Al_2O_3.H_2O$	2
Limonite	$2Fe_2O_3.3H_2O$	7
Magnetite	Fe_3O_4	7
Gypsum	$CaSO_4.2H_2O$	10
Rutile	TiO_2	2
Hematite	Fe_2O_3	1
Tourmaline	Not constant, complex aluminum boro-silicate	2
Siderite	$FeCO_3$	2
Zircon	$ZrSiO_4$	2
Garnet	$Ca_3Al_2Si_3O_2$	1

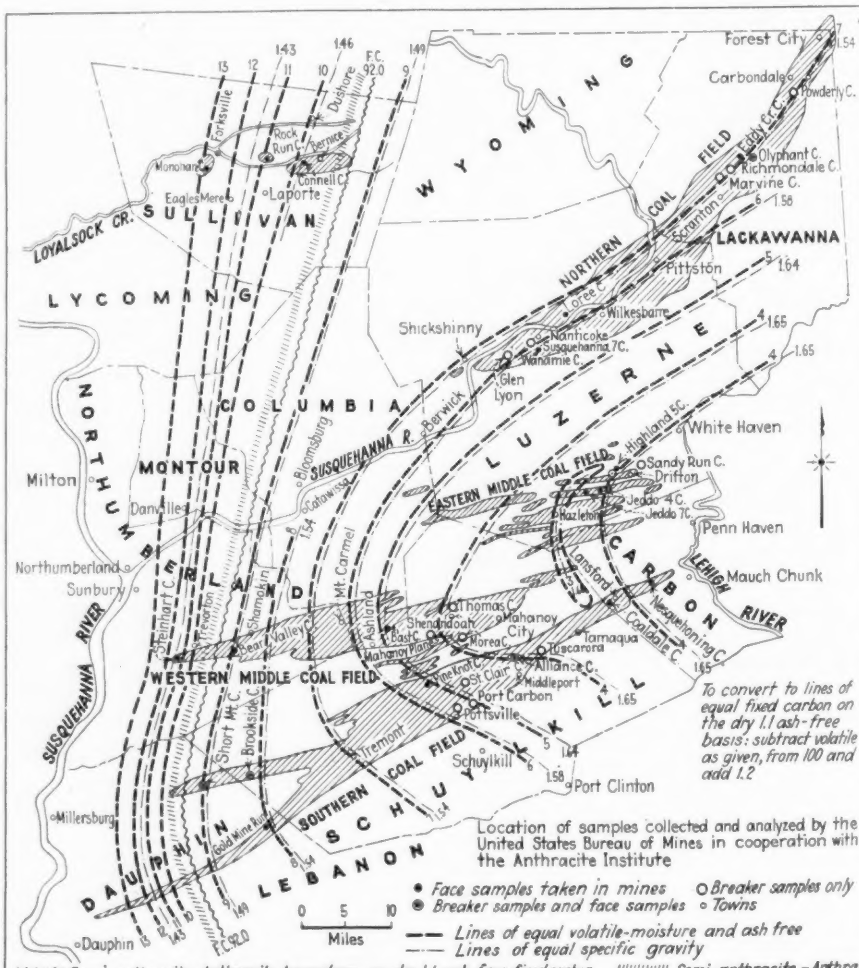
All minerals were identified except prochlorite and penninite. Two chlorites were found and these tentatively have been identified as stated.

Index of grindability should be based on the energy used in grinding a 500-gram minus 10-mesh coal in a ball mill so that 70 or 80 per cent will pass a 200-mesh screen. All that is needed is to count revolutions, said H. F. Yancey, Northwest Experiment Station, in presenting a paper on grindability of coal by himself, O. L. Furse and R. A. Blackburn, University of Washington.

For classification, remarked R. E. Gilmore, in a paper presented by himself, G. P. Connell and J. H. H. Nicolls, Fuel Research Laboratories, coal is rated as coking, even if it will not produce commercial coke. At his station, crucible buttons are kept as standards of non-coking, agglomerating, poor, fair and good coking coals.

Non-coking coal gives a non-coherent residue that can be poured out of the crucible as powder or as flakes or lumps that can be pulverized easily with thumb and finger. More specifically, buttons that will crush under a 500-gram weight are rated as non-coking. Weak buttons that do not crush and indicate no appreciable swelling are graded as agglomerating. Poor coking coal swells but little; its coke is not so opaquely black as that of agglomerating coal, and its buttons support a 2,000-gram weight without pulverizing. In discussion, Mr. Gilmore said the F.R.L. rates all agglutinating coals as bituminous and others as anthracite or lignite.

Fig. 1—Isovol and Specific Gravity Map, Anthracite Region (H. G. Turner).



WHAT HAPPENS

+ When Mineral Is Extracted

SEVERAL excellent papers were presented at the meetings of the Ground Movement and Subsidence Committee, American Institute of Mining and Metallurgical Engineers, Feb. 21 and 22. At the first of these meetings, papers presented related to caving over metal mines where extractions of narrow veins to great depths, often without backfilling, caused breakage to surface far away from the mined area; in a Phelps Dodge Corporation mine, the break was at a maximum draw angle of 45 deg. from the edge of the ore body.

Since the later Walter Herd read his paper on "Bumps in No. 2 Mine, Springhill, N. S." (*Coal Age,* Vol. 34, pp. 158-161) 65 bumps have occurred, raising the number to 357; none, however, as violent as the one detailed by Mr. Herd. R. D. Hall, engineering editor, *Coal Age,* briefly presented the paper of T. L. McCall, chief mining engineer, Dominion Steel & Coal Corporation, which described these later developments. G. S. Rice, chief mining engineer, U. S. Bureau of Mines, presided.

The line of incidence of bumping pressure has moved down the dip from between the 5700- and 5900-ft. levels and now is between the 6300- and 6500-ft. levels, but the longwall workings, that were moving forward toward the area affected by bumps and on the flank of these levels and of the 5900-ft. level, have not been affected. In the two bumps of Nov. 22, 1931, the 6300- and 6500-ft. levels were completely wrecked and damage reached the 6900- and 7100-ft. levels. An air blast blew down most of the doors and stoppings.

Observations made to show the convergence of roof and floor and of the ribs to each other, due to the heavy pressure on the pillars in the neighborhood of these bumps, prove that the coal flows by jerks. Roof and floor have been drilled to obtain some idea of the thickness of the massive roof sandstones where the bumps occurred, and evidence shows that the bumps are most severe where such sandstones are found.

Shooting the pillars would eliminate these bumps, Mr. McCall suggested, but with great accompanying cost for reclaiming the roadways and delay of operations, making the proposition impracticable. The lower levels are being driven single, thus dispensing with the small entry pillars, which are regarded as a source of weakness.

In discussion, Mr. Hall declared that the two limbs of stress arches do not commence at the resistant rocks near the surface, thence arching down to the edges of the two supporting coal pillars, but start some few feet above the middle third of the roof and go down, so that when they arrive above the edge of the pillar they are only a few feet below the bottom of the middle third (see illustration). This is so because wherever the stress line is below the middle third, tension is induced in the crown of the arch, and wherever it is above the middle third, tension is created in the soffit, causing enough failure that compressions increase and the stress arch flattens out.

After the stress line passes the pillar edge it becomes a tangent, as the downward pressures usually are equal to the

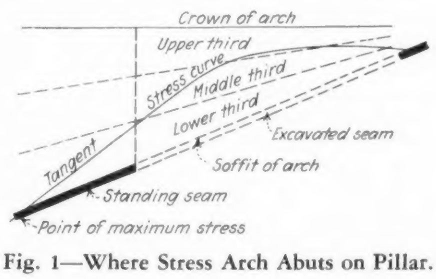


Fig. 1—Where Stress Arch Abuts on Pillar.

upward resistances of the coal. Thus, the stress arch rests not on the edge of the pillar but in the body of the coal, many feet from that edge. Particularly is that true where the roof is deep, the arch span great, and the coal dips steeply, as at Springhill (20 deg.).

Apparently, he added, only when entering or leaving the mine are the miners in danger from bumps. He thought it might be best to approach the longwall either by roads driven well to the dip of the line of incidence of the stress arch or preferably within the unmined area which it spans.

Horizontal movement due to subsidence, declared F. W. Newhall, chief engineer, Northern Coal Mines, Republic Steel Corporation, and L. N. Plein, associate mining engineer, U. S. Bureau of Mines, in a paper presented by Mr. Rice, may cause more destruction to surface structures than the irregular vertical movements of the surface. The maximum angle of observed draw at Merrittstown was 27 deg. 6 min., but this angle was at first only 12 deg. 30 min. Only after a shutdown of sixteen weeks did it reach the larger angle. Further information can be found in *Coal Age,* Vol. 38, p. 97.

At the general session of the Coal Division, Feb. 21, Mr. Rice presented a paper on caving chambers by J. W. Paul, director, CWA, on sealing of mines. To Mr. Paul it seems that the troubles in central Pennsylvania leading to the introduction of caving chambers originate in residual stress from the mountain-forming movements of geologic time. His maps showed caving chambers alongside entries, and other chambers the purpose of which was to relieve the stresses in the roof of rooms. These were placed at the room ends.

However, the relief afforded by such caving chambers, in the belief of Mr. Rice, extends perhaps 400 ft. Widening of rooms, said Mr. Rice, reduces such stresses. In England, it was thought that it decreased unstabilized stresses. J. J. Rutledge, chief mining engineer, State of Maryland, said that in that State, a 20-ft. room could often be maintained where a 9-ft. room would cave. Hence, in recovery operations, pillars are not split but slabbed.

Caving chambers, said L. E. Young, vice-president, Pittsburgh Coal Co., might prove undesirable on retreat and cause a loss of coal.

When failure of roof is delayed several months after the heading has been driven, it seemed to Mr. Hall that it was a mistake to ascribe failure to residual stress, which was as much present when the heading was made as at any time later. Rather should it be attributed to chemical action which, perhaps only in Gallup, N. M., occurs in a few hours. He ascribed the relief afforded by a caving chamber as being due to the ability afforded to expanding drawslates to slip past each other into the free spaces of the cave.

Experiments with samples of roof material shaped like mine roofs and impressed with loads by whirling the material at high velocities were described by P. B. Bucky, assistant professor of mining, Columbia University, in a paper prepared by himself and A. L. Fentress, one of his students, at the meeting of the Mining Methods Section.

NOTES

. . . from Across the Sea

HYDROGENATION of coal under high pressures and temperatures being greatly aided by the presence of certain bodies and being hindered by others, interest has been aroused as to just what bodies the ash of coal contains. In the past, the interest has been confined largely to the silicon, aluminum, iron, calcium, magnesium, potassium, sulphur and phosphorus. Other bodies were suspected to be present, particularly titanium, but until lately no general search has been made to round up all of them.

Goldschmidt and Peters have found the following rare elements in German and British bituminous coal ash:

Table I—Rare Elements in Coal

Element	Mean Quantity, Per Cent	Maximum Quantity Per Cent
Germanium	0.05	1.10
Zinc	——	1.00
Arsenic	——	0.80
Nickel	——	0.80
Boron	——	0.30
Cobalt	0.03	0.15
Beryllium	0.03	0.10
Yttrium	0.01	0.08
Molybdenum	0.02	0.05
Tin	0.02	0.05
Gallium	0.01	0.04
Scandium	0.006	0.04
Lead	——	0.01

Apparently titanium is omitted as not being entitled to the epithet "rare." Now, titanium oxide, which in nature is rutile or brookite, is quite helpful in promoting hydrogenation when in company with oxide of iron. Bergius used 10 per cent of Luxmasse in hydrogenation, and this was found to contain just the right ratio of these oxides to give the best effect, according to an article on "The Progressive Action of Hydrogen on Coal," read by L. Horton, J. C. King and F. A. Williams at the Institute of Fuel, London, England.

It has been found that a vehicle like tar is helpful in promoting hydrogenation. In the absence of such a vehicle, germanium, tin and lead, during the hydrogenation process, greatly aid coal in its conversion into material soluble in chloroform. They lower the temperature at which reaction of coal with hydrogen begins and also speed that reaction. Dispersion of coal in a liquid medium or vehicle increases the yield of liquid products. The vehicle used by the authors was a low-temperature tar from which fractions boiling away below 230 deg. F. had been removed. Catalysts have little effect on the quantities of phenols and basic substances formed but increase the yields of neutral oil.

The use of a vehicle aids hydrogenation, declares the Annual Report of the Fuel Research Board, either because it gives a more uniform distribution of heat, thus reducing the possibility of carbonizing coal, or because it speeds the hydrogenation process by a partial solution of the coal particles in the vehicle or by an increased solution of the hydrogen therein, or both. Catalysts make their influence felt in the early stages. It would almost appear that when coal is hydrogenated without a vehicle, the catalyst, by accelerating the hydrogenation and liquefaction of the coal, forms its own vehicle, the catalyst thereafter exerting little influence.

Molybdenum, says the Research Board, does not appear to be as good a catalyst as tin in the hydrogenation of coal, though particularly helpful in the hydrogenation of tars and oils. Ash from a number of selected coals have been examined spectroscopically to find just what minerals are contained. Germanium has been found usually to be associated with tin.

But hydrogenation seems even in Great Britain to have reached a stalemate. Delivering the Melchett lecture at the Institute of Fuel, Sir John Cadman pointed out that the production of 1 lb. of benzol necessitated the hydrogenation of 1.6 lb. of coal. But 1.6 lb. additional coal, or the equivalent in other fuel, was consumed for each pound of benzol obtained. Moreover, hydrogen had to be provided—about 8,300 B.t.u. for every pound of benzol produced. In all, therefore, 48,300 B.t.u. in coal or other fuel and hydrogen are consumed in the synthetic production of 1 lb. of benzol, which when it is formed has itself a net calorific value of only 18,900 B.t.u. The ratio of potential energy obtained to potential energy expended in the production of the benzol is as 1:2.5, and the thermal efficiency of the operation is only 39 per cent.

WEAKLY CAKING, or what is the same, weakly swelling, coals will produce better coke than they normally would: (1) if the rate of heating the coke oven is increased, (2) if the charge is of suitable density, (3) if the coal is blended with fusain in correct proportion and (4) if it is mixed with a strongly swelling coal, declared R. A. Mott and R. V. Wheeler in a paper read before the Iron and Steel Institute at Sheffield. Relative to rate of heating, they present Table II.

Compression of the coal in the oven favors the first stage of coke formation,

Table II—Effect of Heating Rate on Swelling of Coal

Coal	Total Carbon,* Per cent	Percentage Swelling When Heated 1 deg. C per min.	2 deg. C per min.	3 deg. C per min.
Parkgate (South Yorkshire)	84.8	145	167	177
Barnsley (South Yorkshire)	83.7	79	102	123
Black Shale (Derbyshire)	82.6	12	58	70
Deep Soft (Derbyshire)	81.7	19	33	66
Waterloo (Derbyshire)	81.6	0	0	0

*On ash-free, dry basis.

inasmuch as it facilitates coalescence of coal particles, but it is detrimental in the second stage because, per unit volume of charge, more volatile matter is lost the higher the bulk density. This loss of volatile matter from the rigid mass produces shrinkage cracks which weaken the coke. With a feed of Derbyshire coal blended with 3 per cent of Parkgate fusain, the middle of the oven had 27 per cent of coke remaining on a 4-in. screen, the top only 20 per cent and the bottom only 10 per cent. With 2-in. coke, the shatter index of the middle section was 80, whereas with the top coal it was 77 and with the bottom 67 per cent.

Fusain in the correct proportion controls shrinkage cracks by providing centers for contraction, just as "grog"—pulverized burned clay or brick—controls the shrinkage cracks of fireclay. Tests with the weakly caking Derbyshire coal showed that 3 per cent of fusain effected the greatest improvement in coke. The fusain was most conveniently obtained as dust from a cyclone collector operating on Parkgate (Yorkshire) coal. As this was only 25 per cent fusain, and the rest of the dust was coal which swelled strongly—a characteristic of the coal from the Parkgate seam—and as this part of the dust formed 9 per cent of the entire charge, it must undoubtedly have improved the coke.

Much improvement also is expected from the incorporation with the charge of 3 or 4 per cent of coke-oven tar where weakly caking coals are coked. The Midland Coke Research Committee was sponsor for these experiments.

SOVIET engineers, according to the Moscow *Weekly News,* have found a hard bituminous coal in eastern Siberia, that is acid- and heat-proof, withstanding temperatures up to 750 deg. F. This coal, which has been named "gagat," does not absorb water and will not conduct electricity. It was discovered a half century ago but has recently been brought into prominence by Boris E. Gorin, a Leningrad engineer. It is now being used to replace the conventional alloy of lead, tin and antimony, from which type and space blocks are manufactured. The deposit at Matagansk, near Irkutsk, is said to contain 10,000,000 tons. A government commission is studying the possibility of working it.

It appears that bituminous coal can be converted by temperature and pressure into an almost unburnable material which will not conduct electricity or ab-

sorb water. Bakelite, which is phenol and formaldehyde mixed with powdered wood under great heat and pressure, is extremely heat resistant, does not absorb water and is a non-conductor of electricity. Kolinit, which is a product of lignite, under heat and pressure, has like properties, and these are believed to be the result of a combination of phenol with some other constituent in the coal. The discovery is another link in the chain that may lead us before long to the manufacture of a product of coal that will be valued as a non-combustible and for the qualities ascribed to gagat.

"Gagat" is the Russian word for jet, as "gagath" is the German word, but whether it is justifiable to regard this Siberian product as a true jet is not clear. Anthracite has been formed under great heat and pressure, but it is not remarkably dielectric; it has, however, a low water content. It is also not greatly responsive to fire, possibly because of its density and freedom from volatile matter. Rhode Island anthracite has a low dielectric quality and also has a very high water content—up to 23 per cent. It burns indifferently because of its density, low volatile content and high ash percentage. Neither coal seems to meet the specifications of a Bakelite as does gagat.

R. Dawson Hall

On the ENGINEER'S BOOK SHELF

Requests for U. S. Bureau of Mines publications should be sent to Superintendent of Documents, Government Printing Office, Washington, D. C., accompanied by cash or money order; stamps and personal checks not accepted. Orders for other books and pamphlets reviewed in this department should be addressed to the individual publishers, as shown, whose name and address in each case is in the review notice.

Industrial Research Laboratories of the United States, Fifth Edition, 1933. Bulletin of National Research Council, No. 91. 223 pp. Price, $2.

This publication lists industrial research laboratories, addresses, names of directors, size of staff and nature of research work performed. Somewhat over 1,562 names appear, but it will be noted that the name of the Anthracite Institute does not; nor do colleges and universities engaged in such research. Indexes grouping the laboratories by states and cities and by activities follow. "Coking of Coal" has 27 entries.

* * *

Composition and Byproduct Values of Some West Virginia Coals, by W. W. Hodge and Richard Newton. Research Bulletin No. 9, Engineering Experiment Station, West Virginia University; 56 pp.

This report deals with the composition and carbonizing properties of the following West Virginia coals: Upper Freeport, Preston County; Pittsburgh, Marion County; Pocahontas No. 3, Mercer County; Welch, McDowell County; Chilton, Logan County; No. 2 Gas, Kanawha County; and Sewell, Fayette County. In their discussion of composition, the investigators include both their own proximate and ultimate analyses and the results of tests made by other agencies, notably the U. S. Bureau of Mines and the West Virginia Geological Survey.

Carbonization assays were carried out in accordance with the progressive dry distillation process to determine the yields of gas, coke, tar, light oil, free ammonia, combined ammonia, volatile matter and water, and from these data the yield of gas, coke, tar, light oil and ammonium sulphate in pounds per ton was calculated. In addition, the gases evolved were analyzed for carbon dioxide and monoxide, illuminants, oxygen, methane, hydrogen and nitrogen.

* * *

The Mineral Industries of Pennsylvania, by Raymond E. Murphy. Dr. Charles Reitell, director, Greater Pennsylvania Council, Harrisburg, Pa., distributor. 185 pp. Price, $1.

This timely record of the various mineral products of Pennsylvania brings together the major data on this subject for the first time. Coal received first place, divided into anthracite, bituminous coal and coal processing, which last includes gas manufacture. The petroleum, natural-gas, common rock, clay-products, non-clay refractories, lime, portland cement, iron and steel industries follow, with an article on other metal industries. A final chapter outlines quite briefly the future of the mineral industries of the State with reference to freight rates, taxation, tariffs, overproduction, conservation and general trends. A diagram shows that between 1919 and 1929 the value of Pennsylvania's mineral production fell 5 per cent, and that of the United States as a whole increased 25 per cent.

The author's final conclusion is that Pennsylvania imperatively needs a comprehensive program of research by trained mineral technicians, such as has been started, although in a modest way, by the School of Mineral Industries Experimental Station of the Pennsylvania State College, in cooperation with various branches of these industries in Pennsylvania. This effort should be comparable with that in the agricultural industry. The book contains several valuable charts and chart maps illustrating the progress of the mineral industries and their geographical distribution, respectively.—R. Dawson Hall.

* * *

Electrical Engineering Practice, Vol. III, by J. W. Meares and R. E. Neale. Chapman & Hall, Ltd., 11 Henrietta St., W.C. 2, London, England. 920 pp. Price, 30s.

"In Great Britain the use of electricity is hedged about with an onerous mass of statutory rules issued by the Home Office." This statement, found in a 63-page section devoted to "Electricity in Mining," tells a story of the limited use of electricity underground in British coal mines and of the costly closed-type control equipments used. But the authors temper this somewhat by adding: "Conditions are, however, so special in mines that the safeguard of stringent official rules could hardly have been omitted under any circumstances, and, on the whole, the British regulations have been found conducive to safe working without impeding progress in utilizing electricity in mines."

The mining section of the book is devoted principally to a practical outlining of the general uses of equipment, and incorporates brief data of approximate averages and limitations. Apparently it is an excellent review of best practices in British collieries. As compared to American coal mines, the greater depth of shafts (many over 2,000 ft.), the higher ambient temperatures in the workings due to this depth, and the higher percentage of gaseous mines are the cause for many differences in equipment and applications.

Electric hoisting is less common, flywheel sets are of less advantage because of the longer hoisting cycle, paper-insulated oil-filled cables cannot be used in the deep shafts, electric motors for underground use must be rated for a lower temperature rise, trolley locomotives are prohibited without special permission, and the trailing cable for a mining machine or other portable equipment must contain an "earthing" conductor.

Latest available figures (1931) show 873,000 hp. of electric motors used above ground at British mines and 961,000 hp. below ground. Hoisting may account for 20 to 70 per cent of the total mine load, and electric hoisting efficiencies run between 42 and 63 per cent. Efficiency of electric generation and motor utilization combined is 60 per cent, while that of compressed air "seldom attains 15 per cent." Power requirements for electric machines runs 0.2 to 0.3 kw.-hr. per square yard of undercut, but in difficult cutting may exceed 0.75.—J. H. Edwards.

OPERATING IDEAS

From Production, Electrical and Mechanical Men

Sequence Starting System For D.C. Motors

For sequence starting and stopping of equipment, such as a series of conveyors, where direct-current motors controlled by hand-operated rheostat starters are used, John J. Nolan, Terre Haute, Ind., offers the control system shown in the accompanying diagram. This diagram illustrates the application of the system to sequence starting and stopping of three motors, though any number can be included in a single control circuit, if desired.

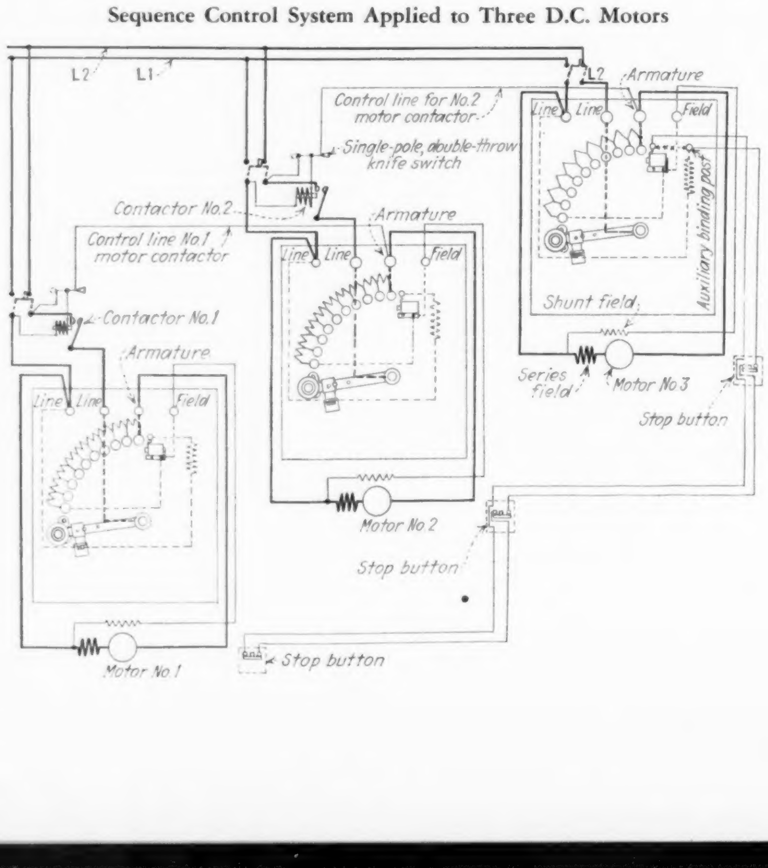
The interlocks provided in this system of control make it impossible to start a motor out of sequence. However, there are times when repairs or other activities make operation of equipment out of sequence a necessity, and to permit this a single-pole, double-throw knife switch is installed at the starter for each of the subsidiary motors. By throwing this switch over from its normal position in the control circuit, the corresponding magnetic contactor is energized and closes, thus allowing the motor to be started separately. Motor No. 3, which is the first motor to start in sequence, can be operated individually at any time.

For emergency stops, as many pushbutton stations as may be desired can be installed at convenient points. These also may be used to shut down the motors at noon or at the end of the shift without making a trip to pull the switch at the No. 3 motor. Use of the pushbuttons also makes it possible to stop equipment from remote points, if desired, and, by properly proportioning the resistance in the circuit, indicating lights may be added to show whether or not the motors are running. When any one of the pushbuttons is pressed, the circuit through the No. 3 motor rheostat holding coil is broken, allowing the starter arm to fall back to the "off" position. This, in addition to stopping the motor, interrupts the flow of current through the control circuit from the armature binding post on the No. 3 rheostat to the holding coil of the No. 2 magnetic contactor. This contactor then opens, breaking the circuit to the No. 2 rheostat holding coil and allowing the starter arm to fall. This arm, in falling, opens the control circuit to No. 1 contactor holding coil, which in turn shuts down No. 1 motor.

In starting up, No. 3 motor is started first. When the starter arm strikes the first button, current flows from the arm through the resistance to the armature binding post and from there to the motor. As the control circuit is connected to the same post, current also flows to the holding coil of No. 2 magnetic contactor, causing it to close. No. 2 motor can then be started, which, in a similar manner, permits No. 1 motor to be started.

In installing the pushbutton circuit, an additional binding post is added to the No. 3 rheostat, and the lead that originally ran from the small resistor inside the case to the holding-coil binding post [*X-X* in the illustration) is shifted to the new post. This post forms one terminal of the pushbutton circuit, with the holding-coil post as the other. Thus the current energizing No. 3 rheostat holding coil while the motor is in operation flows through the entire pushbutton circuit.

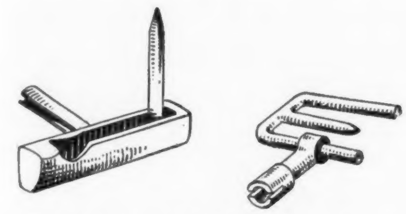
Sequence Control System Applied to Three D.C. Motors



Piercer for Primers

At a recent meeting of the Midland Institute of Mining Engineers, Sheffield, England, a convenient piercer for priming explosives was described by H. G. Grimshaw. One of the chief features of this piercer, developed at the Buxton Safety in Mines Research Station and designed primarily for use with electric detonators, is the fact that it is incorporated in the handle of the pocket-type blasting machine.

Of the two principal forms, the one shown at the right in the illustration has been most favorably received. A pointed copper spike is fitted into a slot in the wooden blasting-machine handle with a



Two Methods of Combining Piercer With Blasting-Machine Handle.

pin at one end to allow it to be opened out like the blade of a pocket knife. When not in use, the piercer is held in place in the slot by a piece of spring steel. For use with ammonium-nitrate explosives, an aluminum or aluminum-alloy piercer is recommended. In the alternative design, the piercer is welded to the center of the U-shaped metal handle, as shown. While not as compact, there are no springs or moving parts to get out of order. Both types were made up at colliery shops.

Make 'Em Count

If your ideas are worth putting into effect around the mine, they are worth telling about in these pages for the benefit of other practical operating, electrical, mechanical and safety men interested in increasing efficiency, reducing costs and making the mining of coal a safer task. Writing skill is not a necessity; simply a clear exposition of the salient points in as many words as may be necessary. A sketch or photograph may help to bring out the major details. The editors will do the rest and, in addition to helping other operating men, you will cash in to the extent to $5 or more for each acceptable idea. Send yours in.

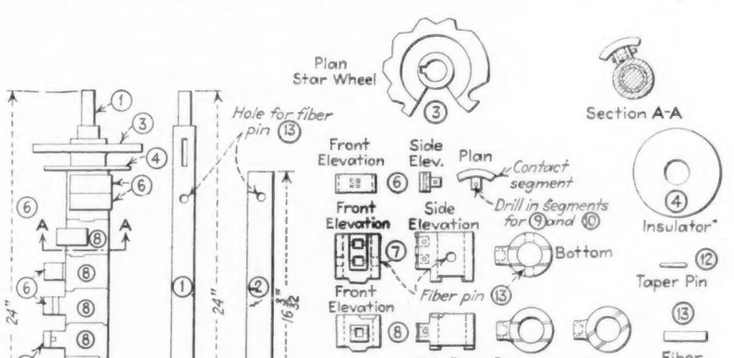
Controller With Sectional Barrel

Dewey Loudermilk, mining engineer, Binkley Mining Co., Clinton, Ind., offers a description of a controller for mine locomotives and cutting machines developed at the Binkley No. 8 mine. For several years, Mr. Loudermilk recounts, trouble was experienced with arcing due to the fact that the screws holding the contacts to the cylinder would work loose. This would result in burns to the finger board and, occasionally, in holes in the cylinder. In addition, trouble was experienced through crystallization of the screws, which would break off in the cylinder, thus requiring considerable labor to remove them if the cylinder was to be salvaged for further use.

In designing the new controller in the latter part of 1932, the use of screws was eliminated by the addition of a lug to the segment which fits into a recess in the cylinder, as shown in the accompanying illustration. The segment is held in place by a tapered pin. This results in a smooth surface over the entire face of the segment, and in case one end is burned, the tapered pin is removed and the segment reversed, thus adding materially to its life. New segments also are much easier to install, it is asserted, and the cylinder is built in sections, so that in case a hole should be burned in a section it is not necessary to discard the entire cylinder.

Since this type of controller was installed in the No. 8 mine, says Mr. Loudermilk, it has been found that it is necessary to inspect them only once a day, at which time greasing of the segments usually is all that is required. One locomotive equipped with this controller, it is asserted, has hauled a total of 250,000 tons of coal a distance of one mile or more with the original segments. The controller was developed by Aaron Slover, chief electrician at the No. 8 mine, who has formed the "Three S Controller Co." to manufacture the equipment for various types of locomotives and mining machines.

Construction Details, Controller With Sectional Barrel and Pinned Segments.



Drawbar End Makes Car Stop

Four Seam Coal Corporation, Diablock, Ky., in changing the type of mine cars, found itself with a number of drawbar ends on hand. These were cut to a length of approximately 2 ft. and used as car stops at the ends of mine tracks. The stop is

Car Stop in Place Against Tie.

placed over the rail and against the end of the last tie, as shown, and is held in place by a pin through the original coupling-pin hole, writes Lloyd G. Fitzgerald.

Switch at Hoist Controls Shaft Gate Locks

The December, 1930, issue of *Coal Age* carried an Operating Idea which described and illustrated an electrical interlock installation on shaft gates arranged to stop the hoist if a gate latch were raised, and to prevent starting of the hoist as long as a gate remained open or unlatched. A gate interlock recently installed at the Dehue mine, in Logan County, West Virginia, handles the situation in a different way. The gate latch cannot be raised until the hoist operative chooses to operate a switch mounted beside the hoist controls.

Referring to Fig. 1, a close-up of a mechanism box on a gate, the latch cannot be raised until the trigger *A* has been pulled down by the magnet coil, which is energized when the switch is closed by the hoist operative. This same switch lights a lamp in the glass-covered box *B*, indicating that power is on the coil and that the latch is free and ready to be lifted.

When the latch is lifted it pushes the spring-return switch *C*, which in turn darkens a signal lamp mounted near hoist operative's controls. This lamp remains dark while the gate is open, and the operative will not start the hoist.

After the gate has been opened a slight bit, the latch is held in the elevated position by the action of the free end of the rod *D*, which butts against a circular section of metal *E* (Fig. 2) mounted on the

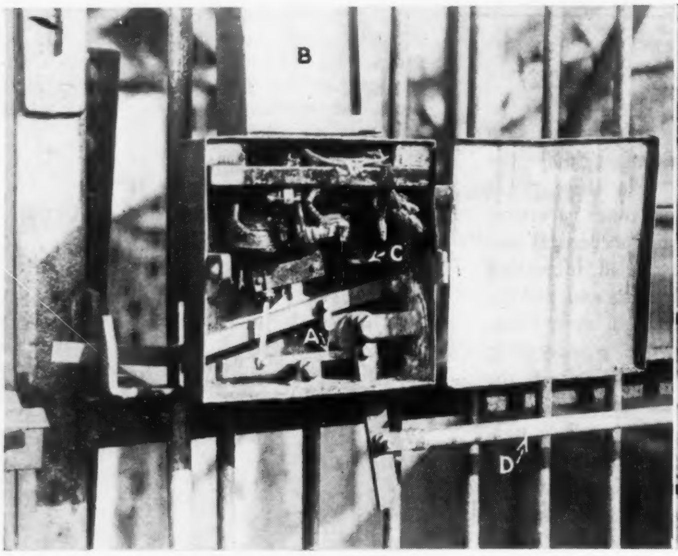


Fig. 1—Close-Up of Latch Box in Position on Shaft Gate.

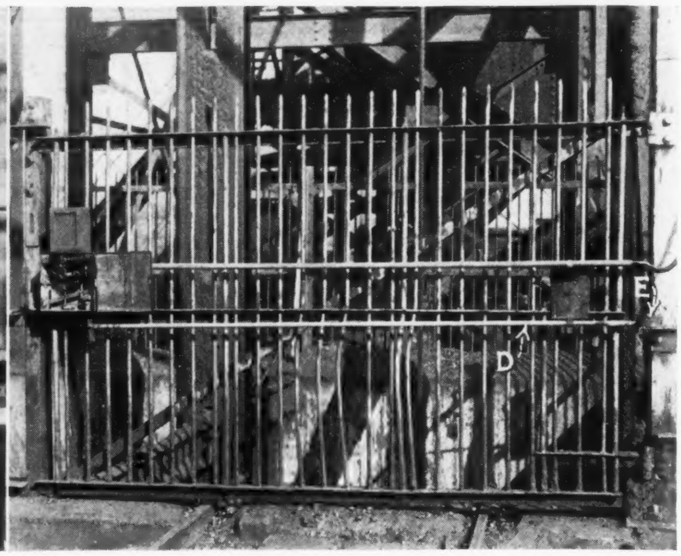


Fig. 2—Gate Is Locked Until Hoist Operative Closes a Switch.

hinge post. A deep notch is cut in the circumference of the metal circle, which is adjusted by rotation until the rod will drop into the notch when the gate is fully closed, thus allowing the latch to fall into position and lock the gate. Covers of the mechanism boxes mounted on the gates are normally closed and padlocked.

Car Equipped So Brakeman Need Not Grasp Edge

When a brakeman rides the end of a mine car it is necessary for him to hold onto something. Ordinarily the top edge of the car body furnishes the only convenient place, but where this is the practice fingers sooner or later are injured or cut off, or it is possible that the brakeman will lose his grip and fall off. Additional hazards grow out of steel cars with sharp edges, large lumps of coal and low top. Equipping cars with handholds is an old practice, yet this feature is often overlooked in the design of new cars. W. E. Davis, superintendent of the two Norfolk & Western Ry. fuel department mines at Chattaroy, W. Va., is now equipping all mine cars at these operations with handholds.

Rod Provides Safe and Convenient Handhold.

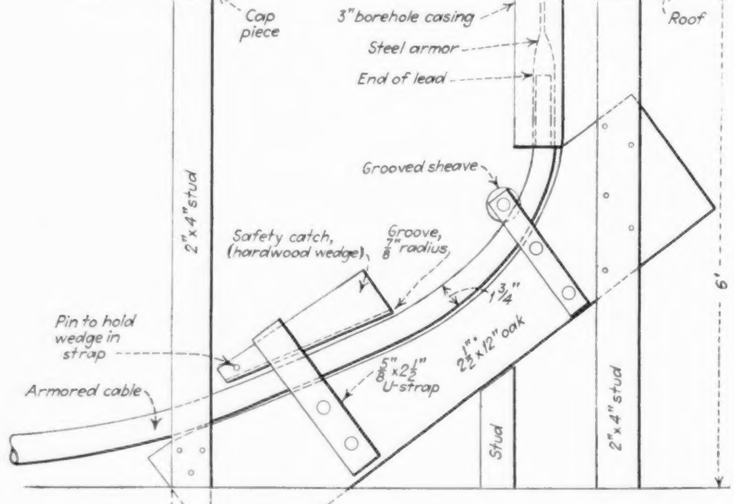
This is being done as the cars come to the main shop for heavy repairs; therefore the cost is nominal, considering safety advantage afforded. The handhold is a ⅝-in. rod about 24 in. long riveted to the car through eyes forged at each end. The fastening is such that there is practically no chance of the rod ever becoming detached and allowing the brakeman to fall. The ⅝-in. size is close to the best for providing a firm grasp.

Installing Cable in Borehole

Frank D. Stovall, chief electrician, Blossburg "E" mine, Brookside-Pratt Mining Co., Blossburg, Ala., describes the method used at that operation to install a steel-wire-armored three-conductor cable in a borehole by which the usual process is reversed and the cable is pulled up through the hole from the bottom. This method was adopted because a rainy spell made the ground so soft that it was impossible to get the cable, which weighed 1,400 lb., to the top of the borehole on the surface.

The first operation in installing the new cable was the removal of the original, which had become too small for the service. This was accomplished by attaching a ⅝-in. wire rope on the surface and lowering it to the bottom of the hole. The wire rope was then attached to the armor of the new cable, and the latter was pulled to the top of the hole with a block and tackle, using the equipment shown in the accompanying illustration to guide the cable into the casing.

Guide Equipment for Installing Cable From Bottom of Borehole.



WORD from the FIELD

Continue War on Substitutes

Anthracite and bituminous operators and representatives of the United Mine Workers and other labor organizations forged vigorously ahead against substitute fuels and energy in February. One of the major targets continued to be the government financing of hydro-electric and oil-fuel projects, with particular stress on the Loup River hydro project. In the latter case, the efforts of bituminous operators and labor organizations to secure a hearing in advance of a decision to build brought forth an expression of opinion from PWA Administrator Ickes to the effect that, "in view of the thorough consideration which has been accorded to this project, I do not feel that the subject matter of the resolution of the National Bituminous Coal Industrial Board would justify either indefinite postponement of construction or reopening the matter for future public hearing." The resolution in question was adopted by the board on Jan. 18 and sent to the White House, which referred it to the PWA Administrator.

Following the lead of Indiana, the Western Kentucky Code Authority last month addressed a protest against all hydro projects and the proposed Missouri Valley development in particular to Kentucky representatives and Senators. Additional protests against the St. Lawrence Seaway were filed by the Logan and Kanawha operators' association. Another major step in the war on uneconomic hydro plants was the organization of the National Job Saving and Investment Bureau late in the month to act as a liaison agent between the bituminous industry, including both the miners and operators, the American Federtaion of Labor, representatives of railroad labor groups and other interested parties. George J. Leahey, Binkley Coal Co., Chicago, was appointed to the organization as representative of the National Coal Association. Ellis Searles, editor, *United Mine Workers' Journal*, represents the miners:

With Norman F. Patton, Anthracite Institute; John L. Lewis and Ellis Searles, United Mine Workers; and C. B. Huntress, executive secretary, National Coal Association, a committee consisting of Charles O'Neill, Peale, Peacock & Kerr, Inc.; J. D. Francis, Island Creek Coal Co.; Grant Stauffer, Sinclair Coal Co.; and A. B. Steffens, Indiana & Illinois Coal Corporation, presented soft coal's proposals for a tax of 5c. per M on natural gas to NRA Administrator Johnson and General Counsel Richberg on Feb. 13. The committee also reminded NRA officials of their promise to cooperate in seeing that the coal industry got a square deal under the code in relation to competitive fuels. General Johnson referred the mater to the Division of Planning and Research, which went into session with the committee on Feb. 13 and 14.

The committee also conferred with Joseph Eastman, Federal Coordinator of Transportation, on Feb. 13, and presented for his consideration a bill designed to place interstate gas lines under the I. C. C. A supplementary conference was held with I. C. C. Commissioner Splawn, the author of a report on pipe lines submitted to a House committee, on Feb. 14. Signs that the work of the industry is bearing fruit were evidenced by a communication from Swift & Co. to the National Coal Association in February declaring that the company had suspended activities which would tend to diminish coal consumption, including the installation of gas at a large Chicago subsidiary and its Omaha plant. Efforts of operators, miners and railroads also played a substantial part in the defeat of a bond issue for a hydro-electric plant at Danville, Va., late in February. The PWA was to have purchased $3,000,000 of the bonds.

The National Coal Association also lent its active support to proposals for a tax of 1 mill per barrel on all oil produced in the United States, as well as a similar tax on all oil refined in the country. Both were included in the draft of the 1934 revenue bill early in February by the House Ways and Means Committee. A proposal to increase the excise tax on imported oil from 21c. to 42c. per barrel was rejected, but attempts will be made to have it restored in the Senate, the association announced.

Coal Production Holds

Bituminous coal production rose to 31,950,000 net tons in February, according to preliminary estimates by the U. S. Bureau of Mines. Production in January was 32,916,000 tons, and the output in February, 1933, was 27,134,000 tons. Anthracite output dropped slightly to 6,123,000 net tons, against 6,125,000 tons in January and 4,275,000 tons in February, 1933.

Total production of bituminous coal in the first two months of 1934 was 64,866,000 tons, an increase of 10,672,000 tons, or 19.7 per cent, over the corresponding total of 54,194,000 tons in 1933. Anthracite output in the first two months was 12,248,000 tons, an increase of 4,166,000 tons, or 51.5 per cent, over the total of 8,082,000 tons in the first two months of 1933.

Appalachian Coals, Inc., Holds Annual Meeting

Featured by reports of excellent progress in its first eight months of operation, the annual meeting of Appalachian Coals, Inc., was held in Cincinnati, Ohio, Feb. 19. Operations of the corporation up to Dec. 31, 1933, netted a profit of $137,979.62, it was reported, and net current assets on that date were $253,023.04. Seven per cent cumulative dividends on preferred stock will be paid as of March 1. All members of the board of directors were reelected, and the directors in turn reelected the officers, as follows: president, James D. Francis, vice-president, Island Creek Coal Co.; vice-president, E. C. Mahan, president, Southern Coal & Coke Co.; treasurer, T. J. Davis, vice-president, Richvein Coal Co.; secretary, R. E. Howe.

Code Conference Postponed; Price Difficulties Ease

With the conference on wages, hours, differentials and other code conditions again postponed, bituminous operators continued the process of smoothing out administrative difficulties in February. Progress also was made in the solution of price correlation questions in and between Divisions I and II. In the latter, Indiana, on Feb. 6, followed the lead of Illinois in approving a settlement based on price stability until March 31, with a trial of Illinois proposals during February and Indiana proposals during March. A fact-finding committee, consisting of George W. Reed, Peabody Coal Co., Chicago; H. B. Lee, Maumee Collieries Co., Terre Haute, Ind.; and H. M. Poole, chairman, Iowa subdivisional code authority (neutral member), was set up to gather data on marketing operations from Jan. 1 for submission to a board composed of an equal number of operators from Indiana and Illinois and empowered to fix prices after April 1.

Progress also was made in Division I as a result of several conferences between the four northern subdivisions, accompanied by price adjustments as between southern low-volatile and central Pennsylvania fields. Correlation between Divisions I and II was the subject of a conference in Cleveland, Ohio, Feb. 16. A plan drawn up at the meeting was referred to the respective code authorities, recommendations to be discussed at a future meeting.

W. Z. Price, formerly with the Buckeye Coal Co., Nemacolin, Pa., and representative of the NRA in the collection of engineering data in Division V, was named technical adviser on coal to the NRA last month. Mr. Price succeeds Frank R. Haas, consulting mining engineer, who returned to private practice.

Northern West Virginia Panhandle producers completed organization of a subdivisional code authority in February, it

is reported, with the appointment of the following personnel: W. H. Koch and R. J. Cotts, Hitchman Coal & Coke Co.; Frank Costanzo and R. L. Berry, Costanzo Coal Mining Co.; E. C. Mobley, Valley Camp Coal Co.; W. D. McKeefrey, McKeefrey Coal Co. of West Virginia; Marshall J. H. Jones, Six States Coal Corporation; and R. M. McQuade, Ben Franklin Coal Co. of West Virginia.

While bituminous operators marked time during preparations for the general wage and hour conference, Washington was the scene of wide action on the NRA front. In preparation for the general meeting of 275-300 code authorities on March 5, a series of hearings to determine the attitude of the general public toward codes and code operation was called by the NRA on Feb. 27. These meetings were featured by an address by NRA Administrator Johnson in which he pointed out twelve general features which experience had shown needed attention. These were:

1. A more uniform and equitable rule of national price stabilization in those cases where it is necessary to maintain wages at a decent standard against the certain results of predatory and cut-throat competition, and further insurance against increase of price faster and further than increase of purchasing power.
2. A more effective rule on costs for the purposes of maintaining rules against sales below costs of production.
3. Uniformity of wages and hourly rates in competitive industries.
4. Uniform classification of areas for the purpose of the North-South differentials.
5. Further reductions in hours per week and further increase in hourly wages.
6. Certainty of protection against monopoly control and oppression of small enterprise, and, especially, the inclusion in codes of adequate buying (as well as selling) provision to guard against oppression of small business.
7. A much improved method for securing prompt and effective compliance.
8. A safe method of financing code administration without racketeering and abuse.
9. Elimination of inconsistent or conflicting provisions among various codes.
10. Adequate labor and consumer representation in an advisory capacity on code authorities.
11. Uniformity of governmental representation on code authorities.
12. Wider use of mechanism for settling labor disputes in connection with code administration.

General Johnson also closed the series with a summary of major problems confronting the NRA, as brought out in the sessions. These were: assurance that price increases will not outrun wage increases; prevention of industrial or labor control against the public interest; code compliance; insurance of the statutory rights of labor; and a maximum contribution by the NRA to the solution of purchasing power and unemployment problems.

Retail Code Signed

A code of fair competition for the retail solid-duel industry was signed by the President on Feb. 14 and became effective Feb. 26. Marketing provisions included in the code provide for filing and posting of prices and also, in the event of an emergency within the industry or any retail trade area growing out of destructive price-cutting, for the determination of the lowest cost within the area that will permit the maintenance of wages, hours, competitive relations and other provisions of the code, below which sales will not be permitted. In approving the code the President added a proviso that a report on operation of the marketing provisions be submitted in order that any changes necessary might be determined within 120 days after the effective date.

The wholesale code was approved by General Johnson on March 1. The code provides for filing prices and charges, but contains no regulatory clauses with the exception that discrimination against any class or group of customers and sale under producers' prices are prohibited.

Rocky Mountain Coal Men Meet in Denver

DENVER, COLO., Feb. 28 — The Rocky Mountain Coal Mining Institute, in the closing session of its 32d regular meeting, here today, joined the growing list of technical societies memorializing Congress for adequate appropriations to carry on properly the work of the U. S. Bureau of Mines for the promotion of safety and efficiency in the mining industry. A second resolution adopted at the same time protested against curtailment in funds necessary for adequate and frequent inspection of mines by State mine inspectors in the Rocky Mountain area.

H. H. Bubb, American Smelting & Refining Co., Cokedale, Colo., was elected president of the institute. J. B. Dick, Gordon Fuel Co., Walsenburg, Colo.; Bruce B. Hanger, Albuquerque & Cerillos Coal Co., Albuquerque, N. M.; A. C. Watts, Utah Fuel Co., Castlegate, Utah, and I. N. Bayless, Union Pacific Coal Co., Rock Springs, Wyo., were made vice-presidents. H. C. Marchant, Pinnacle-Kemmerer Fuel Co., was reelected secretary.

A. K. Krippinger and Homer Harris were elected members of the executive board for Colorado; L. W. White and V. R. McKnight, for New Mexico; H. Peterson and David Brown, for Utah; and Edward Lee and H. H. Gibson, for Wyoming.

As usual, safety discussions had a major part in the program of the three-day meeting. Gilbert Davis, manager, Stag Canon Branch, Phelps Dodge Corporation, told how a ten-year campaign had reduced accident frequency rates from 1.656 to 0.108 and severity rates from 14.458 to 1.106, with sharp increases in the tons produced per lost-time accident and a reduction in compensation costs, exclusive of hospital expense from 2.9 cents to 4 mills per ton. Gratifying reductions in both fatal and non-fatal accidents were reported from Wyoming by David K. Wilson, deputy State mine inspector, who attributed decreases in deaths from falls and transportation to the closer supervision due to the increase in mechanization; rock-dusting and greater use of protective clothing also have contributed materially to improved safety.

Discussing systematic timbering, Robert F. Dalrymple, inspector, Employers' Mutual Insurance Co., emphasized that the time timber is set is just as important as the distance between the timber. James Dalrymple, Sr., chief inspector of mines for Colorado, pointed out that the present system of raising funds to carry on work in that State by the assessment of a tonnage tax leaves the inspection forces with insufficient money to carry on properly in years of low tonnage and also loads the larger mines with too great a proportion of the inspection costs. E. H. Denny, U. S. Bureau of Mines, outlined the work of the Bureau and told how reduced appropriations were curtailing its activities.

Mechanization was the theme of three papers. P. H. Burnell, superintendent, Owl Creek Coal Co., described the system now employed at Gebo, where coal is handled with shaker conveyors and the Burnell loading heads (see February *Coal Age*, page 46). Three entries are driven along the strike, with the bottom entry used for the haulageway and inlet for ventilation and the two top entries for the return.

C. E. Swann, chief engineer, Union Pacific Coal Co., gave the institute the picture of mechanical loading developments of his company and the studies which led up to the adoption of the retreating system of mining with shaking conveyors and scraper loaders.

Turning further east, A. C. Green, manager, central district, Goodman Manufacturing Co., told how the new Hope mine of the Linton-Summit Coal Co., Indiana, had averaged over 500 tons per shift during the first half of February with a new Goodman 260A track-mounted loading machine and track-mounted cutters, with an average labor cost per ton at the parting of approximately 15c.

Codes and the relation of the operating department to new sales policies and problems, touched upon in the opening address of L. R. Weber, retiring president, were followed up in this morning's session, when J. J. Craron explained how more discriminating market demands placed new burdens upon both sales and operating departments, and H. C. Marchant, chairman, Division V Code Authority, and John R. Doolin, secretary, discussed the opportunities and the pitfalls in code administration. How the equipment salesman can help in solving production problems was highspotted by Charles M. Schloss, Lindrooth, Shubart & Co.; Walter Bachman, Care Engineering Co., discussed wheel material, design and manufacture, and Val Cassidy talked on the water problems of the private power plant.

A detailed report of the meeting will be published in the April issue of *Coal Age*.

Convention Plans Under Way

Preparations for the eleventh annual convention and exposition of coal-mining equipment to be held at Cincinnati, Ohio, May 7-11, under the auspices of the manufacturers' division of the American Mining Congress forged ahead in February with a meeting of the program committee in Pittsburgh, Pa., to consider the 300 or more suggestions for papers submitted by the coal operating men. C. M. Lingle, vice-president, Buckeye Coal Co., Nemacolin, Pa., a subsidiary of the Youngstown Sheet & Tube Co., heads the national committee. Regional chairmen are as follows: Illinois-Indiana—C. F. Hamilton, Pyramid Coal Corporation; Far West—I. N. Bayless, Union Pacific Coal Co.; anthracite—C. A. Gibbons, Susquehanna Collieries Co.; Virginia-Kentucky-Tennessee—D. A. Reed, Consolidation Coal Co.; southern West Virginia—C. W. Connor, Nellis Coal Corporation; Pennsylvania-northern West Virginia-Ohio—C. W. Gibbs, Harwick Coal & Coke Co. J. T. Ryan, Mine Safety Appliances Co., heads the manufacturers' division.

Appalachian Wage Negotiations Commence; Alabama Miners Stage Strike

FOLLOWING preliminary conferences on Feb. 21 and 23, negotiations for a new Appalachian wage agreement got under way in Washington on Feb. 28, with Sen. C. W. Watson, receiver, Elk Horn Coal Corporation, Cincinnati, Ohio, as permanent chairman and Thomas Kennedy, secretary, United Mine Workers, and J. William Wetter, general manager, Madeira, Hill & Co., Philipsburg, Pa., as permanent secretary and assistant secretary, respectively. Smokeless operators, desiring to negotiate separately, were not represented, which moved Charles O'Neill, vice-president, Peale, Peacock & Kerr, Inc., and J. D. A. Morrow, president, Pittsburg Coal Co., representing central and western Pennsylvania, respectively, to declare that assurances of establishment of proper competitive relationships with the smokeless field would be a necessary prerequisite to their participation in an agreement. A suggestion by John L. Lewis, international president, United Mine Workers, that smokeless negotiations be conducted along with the general Appalachian conference was accepted with the understanding that differentials would be discussed concurrently. A parallel stand on competitive relationships was taken by Hazard operators with respect to the Harlan field, which was not represented at the opening of the conference, but which later arranged to send a representative to serve on the negotiating committee.

Formal negotiations were opened by Mr. Lewis in a statement in which he presented the recommendations adopted by the scale committee at the biennial miners' convention (*Coal Age*, February, 1934, p. 83) for an increase in wages, a six-hour day and a five-day week, and the adjustment of inequitable differentials.

Mr. O'Neill, on Feb. 29, declared the operators' belief that any change in wage levels would result in much damage to certain districts and properties by increasing the competitive advantages of other regions and that the cost of the shorter work-day would obviate much of the constructive work begun last October. He closed by expressing the operators' willingness to assist in every possible way in the settlement of differentials. J. D. Francis, vice-president, Island Creek Coal Co., Huntington, W. Va., also pointed to the danger of losses due to change in the competitive position through unduly high costs and prices, and added that these also would give additional aid and comfort to substitutes. Mr. Morrow called attention to the fact that higher prices might engender considerable resentment among consumers, making them more promising prospects for oil and gas. Operator representatives were followed up by Mr. Lewis, who took issue with their stand on possible losses and other factors.

Following the presentation of statements, the conference approved the appointment of a negotiating committee of eighteen operators and eighteen miners and adjourned subject to call. Operator members of the committee (in addition to the Harlan representative) are as follows: Northern field—Ohio, R. L. Ireland, Jr., and W. L. Robison; central Pennsylvania, Charles O'Neill, L. W. Householder and A. B. Crichton; western Pennsylvania, J. D. A. Morrow, Scott Stewart and R. H. Jamison; northern West Virginia, W. C. Dobbie and D. A. Reed; Southern field—Logan, J. D. Francis; Kanawha, D. C. Kennedy; Williamson, L. E. Woods; Big Sandy-Elkhorn, E. R. Price; Hazard, W. W. Miller; Virginia, R. E. Taggart; southern Appalachian, L. C. Gunter. Alabama and southern Tennessee also were invited to join the Appalachian group.

A joint committee of ten smokeless operators and ten miners held its first meeting on March 1. Operator members are: Greenbrier, W. G. Crichton; New River, Edward Graff and R. J. Burmeister; Winding Gulf, P. C. Thomas and L. T. Putman; Pocahontas, M. L. Garvey, C. B. Smith and H. C. Faust; Tug River, P. P. Kerr and R. E. Salvati.

Four companies of the National Guard moved into Coleanor, Ala., Feb. 25, to keep order after a strike at mines of the Blockton-Cahaba and Little Cahaba coal companies over the question of union recognition. The stoppage began on Feb. 19, and by the last of the month had spread to the Belle mine, Bessemer Coal, Iron & Land Co.; Boothton operations, Southern Coal & Coke Co.; Straven mine, Peerless Coal Corporation; Aldrich mine, Montevallo Coal Mining Co.; and Underwood mine, Little Gem Coal Co.; according to reports, involving approximately 2,000 miners in Bibb and Shelby counties. On March 4, delegates representing 25 locals were reported to have voted a strike at operations in Walker and Jefferson counties.

With the H. C. Frick Coke Co. leading off, captive mine owners in western Pennsylvania began to affix their signatures to contracts covering mines for which officers of the United Mine Workers had been chosen as representatives of the employees at elections held last year by the National Labor Board. The contracts, while giving the names of the union officials and their titles, in accordance with the recommendations of the board (January *Coal Age*, p. 82), are made with officials as representatives of the men only. Wage rates correspond to those in union contracts covering commercial operations in the region, and the agreements provide for checking-off the dues of members of the United Mine Workers and their remittance to the proper union official. In addition to Frick and other coal-mining subsidiaries of the United States Steel Corporation, contracts were reported to have been signed by the Vesta Coal Co., Inland Collieries Co. and the Republic Steel Corporation.

Attempts of the Progressive Miners of America to extend their power in Illinois received another setback in February when the National Labor Board on Feb. 21 upheld Division II Labor Board in its decision that the United Mine Workers was the rightful representative of Peabody Coal Co. employees in southern Illinois, and that the contract between the company and the United Mine Workers was valid. John M. Carmody, impartial Presidential representative on the labor board for Division I—North, and formerly editor of *Coal Age* and *Factory & Industrial Management*, was elected chairman of the National Labor Board.

The general strike in the northern anthracite region was officially ended by the United Anthracite Miners of Pennsylvania on Feb. 12 to give James A. Gorman, conciliator, and the Anthracite Conciliation Board an opportunity to investigate conditions in accordance with the authority delegated previously by the National Labor Board.

NLA Divorced From NRA

By executive order, President Roosevelt, on March 3, made the National Labor Board an independent organization and gave it the power to report findings and make recommendations either to the NRA Compliance Division or the Department of Justice. Power to review the findings of the board was removed from the Compliance Division, which, however, was left with the authority to take appropriate action thereon. The President's action followed the introduction of a bill in the Senate by Senator Wagner, chairman of the board, on March 1, designed to clarify and strengthen Sec. 7 (a) of the NIRA and make the organization a permanent body.

Demand Limitation and Pumping Discussed at Mt. Hope

Power-demand limitation and mine drainage were the subjects of papers presented at the Feb. 15 meeting of the New River & Winding Gulf Electrical & Mechanical Institute, held at Mt. Hope, W. Va. M. K. Clay, chief electrician, Raleigh Coal & Coke Co., presided. O. G. Crow, electrical engineer, West Virginia Engineering Co., Charleston, covered in detail the rate-schedule structure and conditions which have led some of the mine operators to install demand limiters, and brought out the fact, often lost sight of, that to cut the demand charge portion of the power bill and to reduce the net cost per kilowatt-hour the load factor must be increased.

E. E. Kendall, engineer, Deming Co., Salem, Ohio, brought out many practical considerations not commonly thought of in connection with mine drainage. He mentioned that chrome-iron pumps are now available which under difficult acid water conditions will last four times as long as the all-bronze pumps.

Bureau of Mines Transferred

In accordance with reorganization legislation passed last year, the U. S. Bureau of Mines was transferred from the Department of Commerce to the Department of the Interior by an executive order issued by the President on Feb. 22. The transfer will become effective in 60 days.

New River Decision

Coal not mined in the New River district of West Virginia may not be designated as "New River" coal, according to a decision issued in February by the Federal Trade Commission in the Walker's New River Mining Co. case.

Socialization of Coal Crops Up Again

Conservation and proper coordination of the fuel and power industries are among the "fundamental and unanswerable reasons why government ownership and operation of the coal-mining industry are necessary at the present time," declared W. Jett Lauck, Bureau of Applied Economics, at a conference on "America's Public Ownership Program" Washington, D. C., Feb. 19.

Fundamental principles governing immediate acquisition and operation of coal mines were outlined by Mr. Lauck as follows: authorization of a government credit sufficient to purchase active operations, equipment and reserves; no purchases to be made until it had been determined that the sum would secure requirements of the country for the next 40 years and that operation during the next 50 years would earn interest and sinking-fund payments and permit sale at lower prices than under private ownership; purchase price to be defrayed by the sale of long-term, low-interest bonds, purchase agreements to provide optional utilization of the services of managers and technicians for a stated number of years at a reasonable compensation; purchase legislation to contain a guarantee of miners' rights.

To administer the program and coordinate fuel and power industries, Mr. Lauck proposed a central agency to allocate production and pass on fuel prices; organization of "Divisional Coal Corporations," stock to be held by a "National Coal Corporation" owned by the government; appointment of an administrator for the industry; formation of a "National Coal Planning Board" to assist the administrator; and establishment of "National" and "Divisional Coal Boards" to interpret and apply proposed labor principles and adjust disputes.

"Socialization, or collective ownership and operation of all natural resources as a part of planned economy, is the only solution for the breakdown of the coal industry," declared Mary van Kleeck, Russell Sage Foundation, New York, in a report on Feb. 19. Evidence shows, said Miss van Kleeck, that coal "has for 50 years caused continuous and widespread unemployment, waste of an indispensable and non-restorable natural resource and discrimination against the household consumer in favor of the steel industry, public utilities and other large industrial buyers," and neither the government nor the industry has been able to offer an effective remedy.

Terming the usual nationalization proposal as unpractical and unlikely to succeed as the more conservative recommendations of the U. S. Coal Commission, Miss van Kleeck declared that scientific management must be given freedom to manage the industry, but that such management is possible only as a part of a total planned economy requiring social ownership and administration as "the logical and inevitable next step in the evolution of the economic system." Workers must play an important part in the creation of this new society, and to enable them to do so their organizations must be strengthened. Immediate necessary steps to that end are: unemployment funds for the miners' immediate necessities; freedom for workers' organizations; workers' education and the cooperation of all workers—industrial, technical and scientific—in the study of economic problems; and education of the public in the "protection of human rights against property rights."

If planned economy prevailed, said Miss van Kleeck, scientific management for coal might include: assignment of the task of utilizing coal and other fuels for the maximum benefit to society and the workers to "Fuel Administration"; establishment of a "National Planning Board" to coordinate the fuel industries and "Regional Fuel Authorities" to handle management of properties and the marketing of coal. Employment relations would be covered by a collective agreement with the "Fuel Administration," which would cooperate with the planning board, conduct technical and management research, supervise the work of the regional authorities and jointly work out the rate of development of mines, marketzoning principles and conservation practices.

Lubrication Survey

Engineers of the Sinclair Refining Co., New York, are now making surveys in various major industries to promote a simplified method of selecting the correct grades of lubricants for industrial equipment. Objectives are: better quality, greater economy, elimination of confusion and misunderstanding and reduction in inventories.

Associations

Telford Lewis, president, Jasahill Coal Mining Co., Johnstown, Pa., was elected president of the Somerset County Coal Operators' Association last month. Other officers are: vice-president, L. H. Schnerr, manager, Pennsylvania division, Consolidation Coal Co.; commissioner, Martin Markle, Somerset, Pa.; secretary-treasurer, C. C. Dovey, president, Cambria Fuel Co.; assistant secretary, L. R. Berkey, Johnstown, Pa.

Obituary

DONALD H. COOKSON, 35, combustion engineer, Pittsburgh Coal Co., Pittsburgh, Pa., died suddenly Feb. 17.

BEN I. EVANS, mine inspector for the Mt. Carmel anthracite district, died at a hospital at Danville, Pa., Feb. 15, after a long illness.

WILLIAM EVANS, 62, operating several mines near Blocton, Ala., died suddenly of a heart attack in Birmingham, Feb. 17. Mr. Evans was at different times connected with the operating departments of the Alabama-Blocton, Blocton Red Ash, and Alabama Fuel & Iron companies.

Industrial Notes

ROBINS CONVEYING BELT CO., New York, has acquired the coal and ore-handling business of the Mead-Morrison Mfg. Co., Boston, Mass.

INGERSOLL-RAND CO., Phillipsburg, N. J., has acquired the turbo-blower business of the General Electric Co. and will consolidate it with its own turbo-blower department.

Congress to Meet in Spain

The 1934 International Congress for Technical Education will meet at Barcelona, Spain, May 17-19. Among the subjects scheduled for discussion are the rôle of technical education from the economic and social viewpoints, professional orientation, apprenticeship, apprenticeship and unemployment, openings for higher technical teaching and protection of the title of engineer. The last Congress was held at Brussels, Belgium, two years ago.

Discontinue Federal Relief Coal

The Federal Surplus Relief Corporation late last month discontinued the distribution of relief coal. This action was followed in the case of the Anthracite Institute by an offer to continue the discounts offered on relief coal to State organizations. The anthracite plan was presented to representatives of State emergency relief administrations in seven of the States in the anthracite-consuming territory at a meeting in New York, Feb. 24.

Personal Notes

J. R. CAMPBELL, formerly bituminous representative of the Koppers-Rheolaveur Co., Pittsburgh, Pa., has been appointed special representative of the Island Creek Coal Co. in charge of sales of high- and low-volatile coking coals produced by the company and its subsidiaries in southern West Virginia for metallurgical and other purposes, with headquarters at Cincinnati, Ohio. Mr. Campbell's coal-mining experience also includes twenty years with the H. C. Frick Coke Co. as supervisor of testing and chemical work, coal beneficiation and inspection of coal properties and two years with the Hudson Coal Co.

R. J. IRELAND, JR., vice-president, Hanna Coal Co., Cleveland, Ohio, has been elected to the board of direcotrs of the American Standards Association.

MARSHALL J. H. JONES, president, Six States Coal Corporation, Pittsburgh, Pa., has been elected to the executive board of the Panhandle Coal Operators' Association.

THOMAS E. LIGHTFOOT, safety director, Koppers Coal Co., Pittsburgh, Pa., has been elected to the board of directors of the Western Pennsylvania Safety Council. J. D. A. MORROW, president, Pittsburgh Coal Co., Pittsburgh, has been elected a member of the advisory board.

ANDREW H. SMITH, for several years an instructor on the staff of the Mining Extension Department, University of West Virginia, Beckley, W. Va., has been made superintendent of the Slab Fork (W. Va.) mines of the Slab Fork Coal Co. G. R. SPINDLER succeeds Mr. Smith.

DAVID T. STUART, Belleville, Ill., has been appointed mine inspector for Clinton, Monroe and St. Clair counties, succeeding James R. Richards.

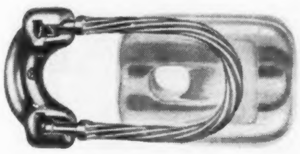
M. M. WATSON, since 1928 industrial representative under the C. F. & I. employee representation plan, has been made superintendent of the Frederick mine of the Colorado Fuel & Iron Co., Valdez, Colo. Mr. Watson succeeds the late Arthur M. Riddle.

WHAT'S NEW

IN COAL-MINING EQUIPMENT

Strain Insulator Fittings

To develop the full strength of porcelain strain insulators, Ohio Brass Co., Mansfield, Ohio, offers a new line of fittings designed to accommodate all the various sizes and makes of standard strain insulators. The new fittings consist of a yoke and a length of stranded cable, each end of which is flash-welded to a turned ball terminal. As the strand conforms perfectly to the contour of the insulator, according to the company, it is possible to develop full insulator strength, due to the fact that the flexible strand bears equally on the porcelain at all points, as compared with the point contacts of rigid fittings.



The yoke has two sockets into which the terminals fit, and the opening in the sockets is placed so as to eliminate the possibility of uncoupling under impact or sudden release of strain on the fittings. In addition, the top of the socket is recessed to receive the ball of the terminal under recoil, an added assurance against uncoupling. Yokes are available with or without an eye or clevis for attachment directly to pole bonds or to such equipment as frogs and crossovers.

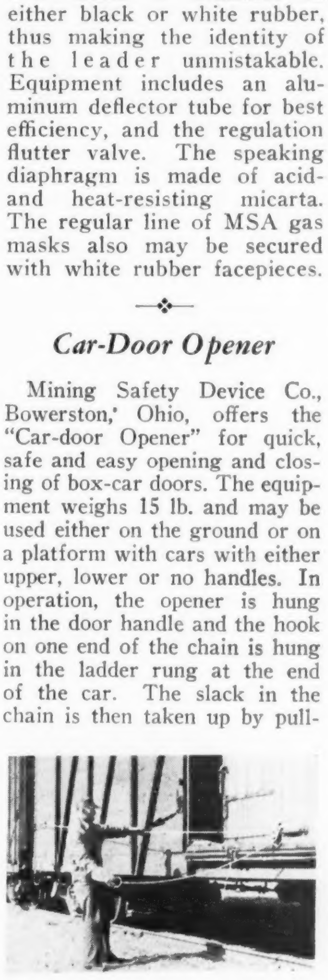
Speaking Diaphragm On Gas Mask

Mine Safety Appliances Co., Pittsburgh, Pa., offers the new MSA speaking - diaphragm facepiece for gas masks to facilitate communication between crew members working in smoke- and fume-filled places and thus increase coordination of work and the safety of the wearers. A special diaphragm is built directly into the mask in front of the mouth to elimi-

nate the muffling effect of the regular facepiece. Speech is transmitted naturally and without distortion, even over telephones or through speaking tubes, according to the company. The facepiece of the new mask is available in either black or white rubber, thus making the identity of the leader unmistakable. Equipment includes an aluminum deflector tube for best efficiency, and the regulation flutter valve. The speaking diaphragm is made of acid- and heat-resisting micarta. The regular line of MSA gas masks also may be secured with white rubber facepieces.

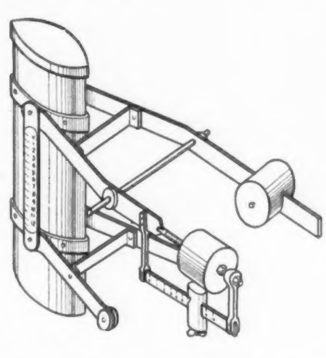
Car-Door Opener

Mining Safety Device Co., Bowerston, Ohio, offers the "Car-door Opener" for quick, safe and easy opening and closing of box-car doors. The equipment weighs 15 lb. and may be used either on the ground or on a platform with cars with either upper, lower or no handles. In operation, the opener is hung in the door handle and the hook on one end of the chain is hung in the ladder rung at the end of the car. The slack in the chain is then taken up by pulling on the ring end, after which the actual door opening is accomplished by short pulls at the center of the stretched chain, the slack being taken up after each pull. Moderate force on the center of the chain, according to the company, exerts a force of over 2,000 lb. on the door, thus making it easy to open the most difficult types. To close doors, the operation is reversed.



Rejection Control

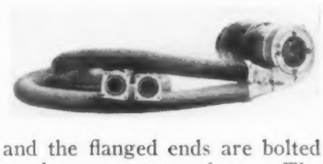
For use with the Norton washer, the McNally-Pittsburg Mfg. Corporation, Chicago, offers an adjustable counterpoise for controlling the refuse gates, which, it points out, can be set for



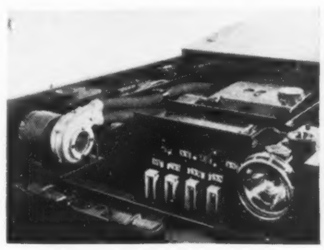
changing the gravimetric separating point between the coal and refuse, and thereby ash content of the clean coal, by moving a sliding weight on the graduated balance beam of the counterpoise. This makes possible, according to the company, the automatic production of coal of any desired ash content without additional adjustment of the washer.

Blowers and Drills

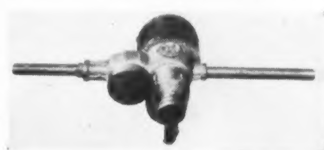
Jeffrey Mfg. Co., Columbus, Ohio, offers new 250- and 550-volt blowers for use on mine locomotives up to 25 tons. This equipment, says the company, will reduce peak temperatures of motors from 25 to 40 deg. C., depending upon the size and load. Each unit is furnished with 16 ft. of hose with a flange on each end, which can be cut to the desired length to suit motor locations. Cut ends are fastened in the blower outlets



and the flanged ends are bolted to the commutator doors. The most effective method is to have the air enter one commutator door and leave the motor through holes drilled in the gear-end housing. A temporary but less effective method is to attach the hose to the lower commutator door and use a baffle to direct the air back over the motor windings to the outlet at the upper com-



mutator door. The hose can be cleated to the locomotive frame or taped in place so that accessibility is not impaired, as is sometimes the case with built-in ducts. Blower motor leads are connected direct to the trolley to provide continuous ventilation. The equipment (shipping weight, 130 lb.) also can be used elsewhere where hot motors are encountered.



Jeffrey also offers the A-7 38-lb. one-man drill, which can be furnished with either open- or permissible-type equipment. Drills with 250-volt permissible-type equipment carry the government approval plate. Features pointed out by the company include the following: greater drilling speed; one-man operation; center of gravity placed back of handles to help counterbalance weight of auger; safety switch controlled by handle (turns off when handle is released and cannot be turned on accidentally); anti-friction bearings throughout for long life; motor cooled by fan-generated internal air circulation; field

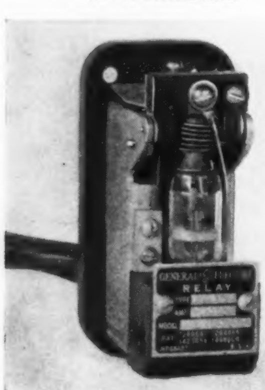
frame made of rolled steel with machined ribs for heat radiation; sturdy construction, with Dardelet self-locking screw threads used throughout and non-ferrous parts of light heat-treated alloy; totally inclosed construction to exclude dust and dirt; easy access to brushes and switch-and-fuse compartment through large screw covers; 1½- to 2-hp. motor compound-wound to prevent racing; specially designed quick-break magnetic switch capable of interrupting several times stalled current; and optional auger sockets for either standard taper-shank or shankless augers.

Relays

General Electric Co., Schenectady, N. Y., offers the Type HBA vacuum-contact, auxiliary-potential relay for use in atmospheres which may contain explosive gases. The equipment is inclosed in a steel container and has single-pole double-throw contacts mounted in a heavy-walled glass tube from which the air has been evacuated. At one end of the tube is a metal bellows. A movable contact is connected to the bellows and operates between two stationary contacts. Normally one contact is closed, and upon application of energy to the coil this contact opens and the normally open contact closes. Relay ratings are: 15 amp. continuous; 10 amp. interrupting at 115 and 230 volts, 60 cycles, a.c., and 125 and 250 volts, d.c.

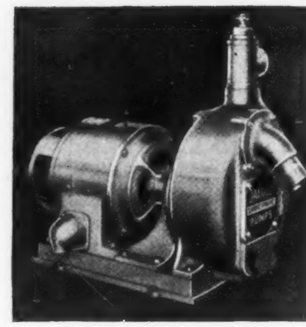
A new line of plunger-type instantaneous and time-delay relays also is offered by General Electric for protection against overcurrent and undervoltage, as well as for auxiliary use. Operating principle is dependent upon the action of a magnet coil in attracting and releasing a plunger at predetermined voltage or current values. The relays are all single-pole and include a variety of adjustments and conversion features. The instantaneous overcurrent relay, according to the company, can be changed from time delay on contact opening or closing or both by placing a poppet in the proper hole; by turning a cap, air intake or outlet from the bellows can be regulated to change the time interval in opening the contacts. Dependability in time delay is secured by the use of superaging rubber which does not require lubrication and is not affected by temperature variations. Other features include changing of hand reset to self-reset contacts, and from circuit-opening to circuit-closing contacts.

Type HBA or HBC Relay, Cover Removed.



Self-supporting steel panels for mounting small oil circuit breakers in isolated places is a further General Electric development. The equipment is suitable, it is said, for ungrounded systems up to 2,500 volts; interrupting ratings vary from 20,000 to 50,000 kva. It consists of an isolated flanged-steel panel with supporting feet welded on. In addition to the breaker, accessory apparatus can be mounted on the panel, and, if desired, a metal guard can be obtained to inclose the back of the equipment from the top of the breaker tank to the top of the panel. The principal advantage pointed out by the company is the fact the panel can be connected up and put in operation immediately upon receipt, inasmuch as it requires no assembly of apparatus or adjustment of breaker mechanism, all this work being done at the factory.

Portable Pumps



Electric-Driven "Sure Prime" Pump With Skid Mounting

Jaeger Machine Co., Columbus, Ohio, offers a line of portable pumping units with suction and discharge lines ranging from 2 to 6 in. Both gasoline-engine and electric-motor-driven models are available, as well as truck and skid mountings. Capacities range from 190 to 50 g.p.m. at 10- to 65-ft. heads for the 2-in. pumps up to 1,950 to 650 g.p.m. at 10- to 100-ft. heads for the 6-in. pumps. Special two-stage centrifugal jetting and high-pressure triplex models also are available. With the exception of the latter two, these pumps are equipped with the "Jaeger Sure Prime" feature, or, in the case of the heavy-duty 4- and 6-in. pumps, with automatic priming pumps. "Sure Prime" equipment, according to the company, holds the prime for days, even in suction lines, and is non-clogging.

Other features pointed out are: only one moving part (the impeller) in the pump; ability to handle up to 25 per cent of solids; lightness (270 lb. for 2-in. electric-driven pumps up to 1,950 lb. for the 6-in. "Sure Prime" model); water passages three to ten times larger than pipes; Jaeger "Lubri-Seal," which supplants packing and packing glands; anti-friction bearings; special large-capacity strainers; self-cleaning shells; and easy inspection.

Contents, Coal Age for March, 1934

With which is consolidated "The Colliery Engineer" and "Mines and Minerals"

 Volume 39, No. 3

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Tonnage, Yardage and Deadwork Scales

(Rates stated in dollars. Tonnage rates are based

CLASSIFICATION*	Ark.-Okla. (21)**	No. Colo. (15)		So. Colo.-New Mexico (15)***	Illinois (12)		Indiana (11)****	Iowa (13)		Kansas-Missouri (14)††	Kentucky-Tenness		
		Louisville	Erie-Frederick		Fulton-Peoria	Springfield		Wayne & Appanoose Counties	Other Iowa†		Big Sandy-Elkhorn (30)†††	Hazard (30)	Harlan (19)
YARDAGE—MACHINE MINING (Contd):													
Crosscuts and breakthroughs, rooms, per yd	1.65												
Under 12½ ft. wide, per yd				0.97[86]									
Heavy pitch, per yd				1.50[83]									
Light pitch, per yd				0.97[83]									
Main slopes and crosscuts, wet, per yd				2.04									
Corner cutting, per yd													
ROOM TURNING—MACHINE MINING:													
General rate					3.1560								
6-ft. wide neck										1.100			
9-ft. neck										1.160			
12-ft. neck										2.220			
7- to 9-ft. neck, under 12 ft. deep							3.2640						
8-ft. neck, 9 ft. deep						4.250			2.090				
12-ft. neck, under 12 ft. deep							2.0400						
Neck over 24 ft. deep				4.49[88]									
Over 30 ft. deep				4.49									
Room and entry turning, including two cribs and brushing, each													
DEADWORK—MACHINE MINING:													
Drawslate, per in. per yd													
3 in., per ton of coal													
Over 3 in., rooms, per in. per yd. 5 ft. wide	0.02												
Over 4 in., per in. per yd												0.055	
Entries, per in. per yd. 8 ft. wide					0.1222								
Rooms, per in. per yd., each 8 ft. width					0.0875								
Over 5 in., per in. per yd													0.040
Over 6 in. (rock and slate and/or top slate), per in. per yd													
Over 6 in. (rock), under 13 ft. wide, per in. per yd													
13 to 18 ft. wide, per in. per yd													
18 to 24 ft., per in. per yd													
6 in., per yd										0.250			
Per ton of coal													
9 in., per yd										0.470			
Per ton of coal													
12 in., per yd										0.570			
Each additional 3 in., per yd										0.110			
Per ton of coal													
Over 12 in., per in. per yd													
15 in , per ton of coal													
18 in., per ton of coal													
Drawslate and impurities, per in. per yd. 5 ft. wide													
Top material, 2 to 5 in., 10x10-ft. section, per ton of coal													
5 to 9 in., per ton of coal													
9 to 13 in., per ton of coal													
Sticky slate, under 10 ft., per ton of coal													
Over 10 ft., per ton of coal													
Sticky coal, extra per ton													
Top or parting coming down with the coal, over 4 in., per in. per yd.													
Bottom slate or impurities, over 5 in., per in. per yd													0.040
False top or bottom, over 3 in., per in. per yd									0.059				
Partings, dirt or rock in seam 1 to 2 in., 20-ft. place, per cut (3½ ft.)													
Each additional in., per cut													
2 to 6 in., per yd													
Over 3 in., per ton per in													
Over 4 in. per in. per yd													
5 in., per yd				0.250									
Each additional in., per yd				0.040									
Over 5 in., per in. per yd													0.040
First 6 in., per in		0.190	0.190										
Over 6 in., per in		0.090	0.090										
6 to 12 in., per yd													
Over 6 in., places under 18 ft., per in. per yd													
18 to 20 ft., per in. per yd													
20 to 24 ft., per in. per yd													
12 to 18 in., per yd													
Rolls, chain-machine mining, over 6 in., per cu.ft							0.034[93]						
Puncher sections, per cu.ft							0.036[93]						
Rolls or horsebacks, 1st 6 in., per yd													
Each additional 3 in., per yd													
Horsebacks, per ft. thick						2.85				0.640			
2 to 6 in					1.0740								
Per additional in. over 6 in					0.0870								
6 to 10 in., per yd													
10 to 17 in., per yd													
17 to 23 in., per yd													
23 to 29 in., per yd													
Clay veins 6 to 12 in., each													
Over 12 in., per ft													
At angle, per yd													
Spar, under 6 in., each													
At angle, per yd													
Shooting niggerheads, over 14 in., each		0.50[95]											
Taking top or bottom for height, first 6 in., per yd													
Each additional 3 in													
Per in. per yd													0.045
Rooms, per in. per yd													
Entries, per in. per yd													
Per in. per yd. 5 ft. wide													
9 in. of material, per yd							0.4250						
Each additional inch, per yd							0.0500						
Rooms and entries, per yd				0.970									0.045
9 in. of material, per yd							0.3460						
Each additional inch, per yd							0.0290						
Per cu. yd				0.970									
Slopes and entries, under 14 ft., per yd				1.470									
Slopes, 6 ft. over rail, per cu.yd				1.220									
Partings, 16 ft., 6 ft. above rail, per cu.yd				0.970									
Top brushing, 1st 12 in., per yd													
Over 12 in., per in. per yd													
5 ft. over rail, per yd										0.940			
5½ ft. over rail, per yd										1.060			
6 ft., per yd										1.170			
Bottom lifting, per in. per yd. 5½ ft. wide					0.0648								
Height, 5 ft. over rail, per yd										1.240			

ork Scales Included in Union Contracts

ated in dollars. Tonnage rates are based on the ton of 2,000 lb. Union districts corresponding to the respective fields are shown in paren

a (13)		Kentucky-Tennessee						West Virginia									
Other Iowa†	Kansas-Missouri (14)††	Big Sandy-Elkhorn (30)†††	Hazard (30)	Harlan (19)	Southern Appal. (19)	Tenn.-Ga. (19)‡	Virginia (28)	Greenbrier (17)	New River (17)	Pocahontas-Tug River (17)	Winding Gulf (17)	Kanawha (17)	Logan (17)	Williamson (17)	W. Va.-Md.: Georges Creek-Upper Potomac (16)†††	Western Kentucky (23)‡‡	Michigan (24)
	1.100																
	1.160																
	2.220																
2.090																	
			0.055							0.060							
				0.040	0.040												
								0.048	0.050				0.048				
							0.048										
							0.060										
							0.072										
	0.250																
	0.470																
	0.570																
	0.110																
																	0.02230
									0.060		0.060			0.060			
				0.040	0.040												
0.059																	
										0.060							
				0.040	0.040												
							0.024										
							0.036										
							0.048										
	0.640																
				0.045	0.045												
									0.060		0.060[98]						
									0.096		0.084[98]						
																	0.07014
				0.045	0.045												
	0.940																
	1.060																
	1.170																
	1.240																
	1.350																
	1.470																

ts for Various Bituminous Fields

arentheses)

Michigan (24)	Ray & Clay Cos., Missouri (25)‡‡‡	Montana (27)	Ohio-No. West Virginia: Hocking (6)	Ohio-No. West Virginia: Coshocton (6)	Ohio-No. West Virginia: Massillon (6)	Ohio-No. West Virginia: E. Ohio & No. W. Va. Panhandle (6)	Pennsylvania: Central and Somerset Co. (2)	Pennsylvania: Western: Thin Vein, District 5	Pennsylvania: Western: Thick Vein (5); Districts 3 & 4	Utah (22)	Washington (10)§	No. W. Va. (31)	Wyoming (22): Southern§§	Wyoming (22): Northern§§§
			0.50400[78]											
	0.8600[87]													
	3.3975													
			........[99]		0.030									
					0.060									
					0.100									
					0.130									
						[90]		0.054[91]	0.054					
					0.160									
					0.200									
.02230														
	0.0060[92]													
	0.0360[92]													
	0.0060[92]													
	0.0600													
	0.1160													
					0.040									
		0.2250												
		0.2250												0.5500
										0.0067			0.0067	0.0067
														1.1000
														1.6600
				0.3900										
				0.1950										
						0.320[94]								
						0.540[94]								
						0.880[94]								
						1.110[94]								
								1.3700	1.3700					
								1.3700	1.3700					
								0.3500	0.3500					
								0.7900	0.7900					
								0.1300	0.1300					
					0.470									
					0.235									
						0.3700[94]								
.07014														
			0.86400[97]											
			0.06340[97]											

6 ft., per yd.
Bottom lifting, per in. per yd. 5½ ft. wide .... [illegible]
Height, 5 ft. over rail, per yd.
5½ ft., per yd.

		1.240																
		1.350																
		1.470																

6 ft., per yd													
Bottom lifting, per in. per yd. 5½ ft. wide					0.0648								
Height, 5 ft. over rail, per yd										1.240			
5½ ft., per yd										1.350			
6 ft., per yd										1.470			
Entries, longwall, brushing 5 ft. wide, per yd								0.55					
Entry width, incl. drilling, shooting and loading, per in. per ft.		0.018[98]	0.018[98]										
Company drilling and shooting, per car		0.38[98]	0.38[98]										
Drilling and shooting, unnecessary, per in. per ft		0.014[98]	0.014[98]										
Brushing entries, per yd													
Entries, shooting unnecessary, per in. per yd							0.0380						
Rooms, shooting unnecessary, per in. per yd							0.0290						
Brushing, roadways, 22 in. below bottom, 5 ft. wide, per yd													
Over 22 in., per in. per yd													
Brushing, 1st 6 in., 5 ft. wide, per yd													
Each additional inch, per yd													
6 to 12 in., per yd													
12 to 18 in., per yd													
Rock shooting, roadways, per yd													
Loading rock, per car		0.380	0.520										
Off haulways and hauling to parting, per car				0.600									
Loading falls on roadways, longwall, per car								0.13					
Hauling rock with mules, per car				0.085									
With hoist, per car				0.085[102]									
Loading rock or water, per car				0.410									
Cleaning up falls at face, over 3 in., per in. per yd									0.059				
Gob or pack walls, per yd										1.750			
Double, per yd													
Gob entries, under 10 ft., incl. lifting not over 18 in. of bottom, per yd.													
Hauling coal to parting, per car		0.080[88]											
Hauling coal with mule, per ton				0.050									
With hoist, per ton				0.05[102]									
Wheeling coal, 300 ft., per ton													
Next 75 ft., per ton													
Next 75 ft., per ton													
Pushing coal, under 150 ft., per ton									0.090[48]				
Setting crossbars, entries				0.49[107]									
Rooms				0.250									
Rooms, over 12-ft. collars				0.490									
Setting timbers, over 8 in., when unloaded over 50 ft. from working place, each													
Setting crossbars and split props, each													
Recovering props, per ft				0.010									
Building cribs, each								0.65					
Water, handled by miner, per yd				0.480									0.
Bailing water, per bbl													

CUTTING SCALES:

Chain machines, runner, per ton					0.0700		0.0425	0.07		0.08			
Helper, per ton							0.0425	0.07		0.07			
Shoveler, per ton								0.07					
Punchers, per ton		0.20	0.150										
Runners, per ton							0.0810						
Helpers, per ton							0.0740						
Breast machines, per ton													
Wide work, per ton													
Narrow work, per ton													
Including drilling, per ton													
On block system, per ton													
Including drilling, per ton													
Shortwall machines, per ton		0.13				0.075					0.080	0.080	
Wide work, per ton													
Over 18 ft., per ton													
Per place		2.10	2.100										
Narrow work, per ton													
Per place		1.90	1.900										
Coal 2⅓ to 3 ft., per ton													0.
2½ to 2¾ ft., per ton													
2¾ to 3 ft., per ton													
3 to 3½ ft., per ton													
3 to 3⅔ ft. per ton													0.
3½ to 4 ft., per ton													
3⅔ to 4⅓ ft., per ton													0.
Under 4 ft., 6 to 7½-ft. bars per ton				0.116									
Over 4 ft., per ton													
Over 4⅓ ft., per ton													0.
Over 4½ ft., per ton													
4 to 6 ft., 6 to 7½-ft. cutter bars, per ton				0.106									
Under 5 ft., per ton			0.097										
Over 5 ft., per ton			0.090										
Under 6 ft., per ton				0.106									
Over 6 ft., 6 to 7½-ft. cutter bars, per ton				0.095									
6 to 8 ft., per ton				0.085									
Over 8 ft., per ton				0.074									
Heavy pitch, under 5 ft., per ton				0.148									
5 to 6 ft., per ton				0.138									
Over 6 ft., per ton				0.127									
Light pitch, under 5 ft., per ton				0.116									
5 to 6 ft., per ton				0.106									
Over 6 ft., per ton				0.095									
Place 10 ft. wide, 6 to 7½-ft. cutter bars, per cut				1.170									
15 ft., per cut				1.620									
20 ft., per cut				1.980									
25 ft., per cut				2.250									
30 ft., per cut				2.450									
Undercutting, per ton		0.16[88]											
Coal under 5 ft., per ton													
Over 5 ft., per ton													
Cutting, rooms, per ton													
Entries and breakthroughs, per ton													
Rooms, per place													
Entries, per place													
Cutting, narrow work, runners, per ton													
Helpers, per ton													
Wide work, runners, per ton													
Helpers, per ton													
Cutting, places under 12 ft., per sq.ft													
Over 12 ft., per sq.ft													
Arcwall machines, per ton													
Wide work, per ton													
Places over 18 ft., per ton													
Narrow work, per ton													
Track-mounted machines, per ton											0.049	0.056	
Over 5 ft. coal, per ton													
Top cutting, per ton													
Undercutting, per ton													
Cutting and drilling, per ton													
Cutting and shearing, per ton													
Cutting, shearing and drilling, per ton													
Runners and helpers, per ton													
Cutting and shearing, per ton				0.058									
Undercutting and shearing, wide work, per ton			0.065										
Per place			1.900										
Narrow work, per ton			0.065										
Per place			1.700										

YARDAGE—CUTTING:

Chain machines, 6-ft. places, runner, per yd										0.200			
Helper, per yd										0.200			
Narrow entries, 7 to 9 ft., machine crew, each per yd							0.0780[77]						
Wide, or 12-ft., entries, machine crew, each per yd							0.0470[77]			0.130			
15-ft. places, runner, per yd										0.100			
Helper, per yd										0.100			
Punchers, narrow entries, machine crew, each per yd							0.095[114]						
Wide entries, machine crew, each per yd							0.058[114]						
Shortwall machines, narrow work, per yd													
8-ft. places, per yd						0.670							
10-ft., per yd						0.560							
Under 12-ft., per yd													
12-ft., per yd						0.470							
20-ft., per yd						0.150							
Undercutting, entries and crosscuts, per yd													
Room necks, room crosscuts, per yd													
Planes, plane crosscuts, per yd													
Cutting, narrow work, 8-ft. places, per yd					0.4200								
Under 12 ft., per yd													
12 ft., per yd					0.2880								
Room turning, machine crew					1.0500								
6 ft. wide neck, runner										0.265			
Helper										0.265			
8-ft. neck, 9 ft. deep, machine crew						0.930							

		1.240 1.350 1.470																
.55																		
.13																		
	0.059	1.750																
	0.090[48]																	
.65					0.200	0.200												

.07 .07 .07		0.08 0.07															0.0305 0.0302	
			0.080	0.080				0.067	0.055	0.075	0.045	0.070	0.070	0.052	0.056	0.080		
					0.08	0.085 0.082 0.080												
					0.070 0.060	0.078												
					0.050	0.075												
																		0.13200 0.15720
						112										0.048		
			0.049	0.056	112	112		0.047	0.039	0.053	0.032	0.049	0.045	0.036	0.039			

		0.200 0.200																
		0.130 0.100 0.100																
		0.265 0.265																

											2.30[99]			
	1.0100[100]													
	0.0600													
				0.4650										
				0.0770										
		0.6850												
		1.1350												
	2.4100[101]													
		0.9050												
	0.2900													
	0.5600													
	1.770[103]													
	0.090[104]													
	0.136[105]													
	0.1587[106]													
				0.0560	0.056									
											0.295			
											0.930			
	0.6150													
				0.3900	0.390									
				0.0630		0.0600								
				0.1000	0.100							0.080		
			0.09000			0.0900								
			0.09000[108]											
												0.092		
												0.075		
												0.087		
				0.0800	0.090		0.080					0.060		
			0.08000			0.0800		0.080	0.070[109]					
			0.08000[108]					0.080	0.070[109]					
										0.100				
										0.080				
													0.12	
.13200[109]	0.210[110]												0.08	
.15720[109]														
														1.92[111]
											0.075			1.48[111]
											0.065			
											0.065			
											0.060			
		0.0388												
		0.0253												
							0.055							
			0.06500											
			0.06500[108]											
								0.058	0.048					
												0.044		
												0.048		
								0.060	0.050			0.055		
						0.0500		0.060	0.050			0.060		
						0.058[113]		0.062	0.052			0.068		
										0.080				
			0.14400[115]					0.170	0.190					
				0.4400[116]	0.441[116]									
				0.3025[116]	0.302[116]									
				0.1760[116]	0.176[116]									
													0.6800	
													0.6400	
													0.6400	
						0.1985[117]								
										0.690				
						0.1440[117]								

CLASSIFICATION*	Ark.-Okla. (21)**	No. Colo. (15)		So. Colo.-New Mexico (15)***	Illinois (12)		Indiana (11)****	Iowa (13)		Kansas-Missouri (14)††	Kentucky-Tennes		
		Louisville	Erie-Frederick		Fulton-Peoria	Springfield		Wayne & Appanoose Counties	Other Iowa†		Big Sandy-Elkhorn (30)†††	Hazard (30)	Harlan (19)
Helpers, per ton													
Wide work, runners, per ton													
Helpers, per ton													
Cutting, places under 12 ft., per sq.ft													
Over 12 ft., per sq.ft													
Arcwall machines, per ton													
Wide work, per ton													
Places over 18 ft., per ton													
Narrow work, per ton													
Track-mounted machines, per ton													
Over 5 ft. coal, per ton											0.049	0.056	
Top cutting, per ton													
Undercutting, per ton													
Cutting and drilling, per ton													
Cutting and shearing, per ton													
Cutting, shearing and drilling, per ton													
Runners and helpers, per ton													
Cutting and shearing, per ton				0.058									
Undercutting and shearing, wide work, per ton			0.065										
Per place			1.900										
Narrow work, per ton			0.065										
Per place			1.700										
YARDAGE—CUTTING:													
Chain machines, 6-ft. places, runner, per yd										0.200			
Helper, per yd										0.200			
Narrow entries, 7 to 9 ft., machine crew, each per yd							0.0780[77]						
Wide, or 12-ft., entries, machine crew, each per yd							0.0470[77]			0.130			
15-ft. places, runner, per yd										0.100			
Helper, per yd										0.100			
Punchers, narrow entries, machine crew, each per yd							0.095[114]						
Wide entries, machine crew, each per yd							0.058[114]						
Shortwall machines, narrow work, per yd													
8-ft. places, per yd						0.670							
10-ft., per yd						0.560							
Under 12-ft., per yd													
12-ft., per yd						0.470							
20-ft., per yd						0.150							
Undercutting, entries and crosscuts, per yd													
Room necks, room crosscuts, per yd													
Planes, plane crosscuts, per yd													
Cutting, narrow work, 8-ft. places, per yd					0.4200								
Under 12 ft., per yd													
12 ft., per yd					0.2880								
Room turning, machine crew					1.0500								
6 ft. wide neck, runner										0.265			
Helper										0.265			
8-ft. neck, 9 ft. deep, machine crew						0.930							
9-ft. neck, runner										0.400			
Helper										0.400			
12-ft. neck, runner										0.520			
Helper										0.520			
Corner cutting, longwall, semi-longwall, per yd								0.65					
DEADWORK—CUTTING:													
Shortwall or track-mounted machines, clay veins, 6 to 12 in., each													
Over 12 in., per ft													
At angle, per yd													
Spar, 6 in., each													
At angle, per yd													
Horsebacks, 2 to 6 in., machine crew					0.5400								
Each additional inch, machine crew					0.0438								
Rolls, chain machine, per cu.ft							0.034						
Punchers, per cu.ft							0.036						
DRILLING SCALES:													
Per ton													
Coal under 5 ft., per ton (including shooting)													
Coal over 5 ft., per ton (including shooting)													
One man, powder furnished													
Two men													
Drilling and tamping, coal over 5 ft., per ton													
Drilling and shooting, Cardox, pillar work, drillers, per ton													
Helpers, per ton													
Shotfirers, per ton													
Drilling and shooting, Cardox, rooms and entries, drillers, per ton													
Helpers, per ton													
Shotfirers, per ton													
YARDAGE—DRILLING:													
Drilling and shooting, entries and crosscuts, per yd													
Room necks and room crosscuts, per yd													
Planes and plane crosscuts, per yd													
MECHANICAL LOADING:													
Per ton													
Conveyor mining, per ton													
Full seam, per ton													
Low seam, per ton													

[81] Subdistrict No. 2; No. 3, 80c.; also applies to breakthroughs. [82] Crested Butte; Nonac, $1.20; Cameron, slopes and entries, $1.50, divided 60-40 between loader and cutter. [83] Cameron, divided 60-40 between cutter and loader. [84] Crested Butte; Nonac, $1.20; Cameron, 97c., divided 60-40 between loader and cutter. [85] Divided one-third to company, loader and machine crew.

[86] Crested Butte; Nonac, 90c.; Cameron, 97c., divided 60-40 between loader and cutter. [87] Missouri City, 86½c.; Rayville and Elmira, 81¾c. [88] Cameron, Kebler and Nonac, first two being divided 60-40 between loader and cutter. [89] Hocking slate scale: 30-ft. places—1 in., 6c. per yard; running up to 24 in., $1.44 per yard; 24-ft. places—1 in., 5½c.; running up to 24 in., $1.32; 18-ft. places—1 in., 4½c.; running up to 24 in., $1.10; 15-ft. places—1 in., 4c.; running up to 24 in., 99c.; 12-ft. places—1 in., 3½c.; running up to 24 in., 87½c.; 8-ft. places—1 in., 3c.; running up to 24 in., 66c.

[90] Eastern Ohio—Northern West Virginia Panhandle slate scale: 24-ft. places, first inch over 12 in., 7c., running up to 48 in., $3.23; 18-ft. places, first inch over 12 in., 5c.; running up to 48 in., $2.42; 12-ft. places, first inch over 12 in., 4c.; running up to 48 in., $2.16; 8-ft. places, first inch over 12 in., 3c.; running up to 48 in., $1.62.

[91] No scale for Thick Vein Freeport. [92] Missouri City, top material, 10 to 27 ft. in rooms, 10c. per ton extra; 27 ft. up to full room depth, 20c. per ton extra. [93] To be divided among loaders and cutters in same proportion as regular work. [94] Amsterdam-Bergholz district. [95] Monarch mine.

[96] Wide work, over 14 ft.; narrow work, under 14 ft. [97] Mines north of Shawnee and Crooksville field, entries over 4½ ft. over rail.

...nooseCounties	Other Iowa†	Kansas-Missouri (14)††	Kentucky-Tennessee: Big Sandy-Elkhorn (30)†††	Hazard (30)	Harlan (19)	Southern Appal. (19)*	Tenn.-Ga. (19)‡	Virginia (28)	West Virginia: Greenbrier (17)	New River (17)	Pocahontas-Tug River (17)	Winding Gulf (17)	Kanawha (17)	Logan (17)	Williamson (17)	W. Va.-Md.: Georges Creek-Upper Potomac (16)†††	Western Kentucky (23)‡‡	Michigan (24)
						[112]										0.048		
			0.049	0.056	[112]	[112]		0.047	0.039	0.053	0.032	0.049	0.045	0.036	0.039			
		0.200																
		0.200																
		0.130																
		0.100																
		0.100																
		0.265																
		0.265																
		0.400																
		0.400																
		0.520																
		0.520																
.65																		
																0.361[121]		
																0.401[121]		

(Column group heading: owa (13) over the first two columns.)

...rst inch over 12 in., 4c.; running up to 48 in., $2.16; ...t inch over 12 in., 3c.; running up to 48 in., $1.62. ... for Thick Vein Freeport. [92] Missouri City, top ... 27 ft. in rooms, 10c. per ton extra; 27 ft. up to full ...0c. per ton extra. [93] To be divided among loaders ... same proportion as regular work. [94] Amsterdam-...ct. [95] Monarch mine. ..., over 14 ft.; narrow work, under 14 ft. [97] Mines ...ee and Crooksville field, entries over 4½ ft. over rail,

86c.; each additional inch, 6½c. When bone coal is brushed for height in this field, loader shall receive 2.65c. per ton extra; cutter, 1½c. Taking present material in mines of the Muskingum Coal Co., 3.7c. per yard where material is shot with the coal. [98] Bottom coal in entries not in excess of 4 in. taken up in connection with brushing to be paid at brushing rate. Bottom lifting rate at Crown mine, company drilling and shooting, 1½c. per inch per foot. [99] When loaded into cars, $2.52½. [100] Including double road walls 18 in. wide.

[101] Entries 5½ to 6 ft. high, 4 ft. wide at top, ... including 3-ft. walls and wheeling not over 300 ft. ... $2.16; double-track entry, $2.50; Richmond-Swanv... ville, $3. [102] Crested Butte; Kebler, 7c. [103] ... [104] Missouri City, 91½c. [105] Rayville, 12½c.; Mosb... [106] Rayville and Mosby, 15c. [107] Nonac, ... breakthroughs and room turning; rate is in add... scale. [108] Low-coal differentials: 21-24 in., 2.88c...

Michigan (24)	Ray & Clay Cos., Missouri (25)‡‡‡	Montana (27)	Ohio-No. West Virginia: Hocking (6)	Ohio-No. West Virginia: Coshocton (6)	Ohio-No. West Virginia: Massillon (6)	Ohio-No. West Virginia: E. Ohio & No. W. Va. Panhandle (6)	Pennsylvania: Central and Somerset Co. (2)	Pennsylvania: Western: Thin Vein, District 5	Pennsylvania: Western: Thick Vein (5); Districts 3 & 4	Utah (22)	Washington (10)§	No. W. Va. (31)	Wyoming (22): Southern §§	Wyoming (22): Northern §§§
														1.92[111]
														1.48[111]
											0.075			
											0.065			
											0.065			
											0.060			
		0.0388												
		0.0253												
							0.055							
			0.06500											
			0.06500[108]											
								0.058	0.048					
												0.044		
												0.048		
								0.060	0.050			0.055		
						0.0500		0.060	0.050			0.060		
						0.058[113]		0.062	0.052			0.068		
										0.080				
			0.14400[115]					0.170	0.190					
				0.4400[116]	0.441[116]									
				0.3025[116]	0.302[116]									
				0.1760[116]	0.176[116]									
													0.6800	
													0.6400	
													0.6400	
						0.1985[117]								
										0.690				
						0.1440[117]								
								0.35	0.35					
								0.35	0.35					
								0.08	0.08					
								0.14	0.14					
								0.04	0.04					
						[118]								
						0.022[119]								
													0.1200	
													0.1000	
										0.050				
										0.060				
										0.075				
										0.040				
										0.035				
										0.040				
										0.045				
										0.040				
										0.045				
													0.95	
													0.72	
													0.72	
				0.4700										
				0.4700			0.435[120]							

top, 10 ft. at bottom, ...00 ft.; Missouri City, ...Swanwick, $2.89; Ray- ... [102] Rayville, $1.695 ... Mosby, 13c. ...ac, 24c. [108] Includes ... addition to tonnage ... 2.88c. per ton; 24-27 in., 1.24c.; 27-30 in., 0.62c. [110] To be divided equally among crew members in accordance with footage cut. [111] Eight-foot cutter bars, rooms, $2.29; entries, $1.75. [112] Seventy per cent of shortwall rate. [113] Northern West Virginia Panhandle only. [114] In case coal is sheared, machine runner and helper receive all the yardage; in case machine works by the day, loaders to receive all the yardage; includes breakthroughs. [115] In addition to tonnage scale. Same rate applies to cutting with breast and arcwall machines.

[116] Includes breast machines. [117] Entries, breakthroughs and room necks. [118] Amsterdam-Bergholz district, horsebacks 10 to 17 in. in thickness, cutter, 11c.; 17 to 23 in., 24c.; 23 to 29 in., 38c. [119] Amsterdam-Bergholz district only, power drill. [120] Somerset, except at Nos. 37 Upper, 37 Lower, 40 Upper and 40 Lower mines of the Berwind-White Coal Mining Co., where the rate, subject to investigation and arbitration, is 40.1c. per ton. [121] Davis Coal & Coke operations in the Kittanning seam; subject to investigation and arbitration.

Tonnage, Yardage and Deadwo

(Rates state

CLASSIFICATION*	Ark.-Okla.[1] (21)**	No. Colo. (15)		So. Colo.-New Mexico (15)***	Illinois (12)		Indiana (11)****	Iowa (1	
		Louisville	Erie-Frederick		Fulton-Peoria	Springfield		Wayne & Appanoose Counties	
PICK MINING, PILLAR MINING:									
General rate, per ton	0.72	0.760[1]	0.700	0.680	0.7500[2]	[2]	0.6800		0.8
Per car									
Hand-picked coal basis, per ton								1.30[10]	
Screened-lump basis, per ton								1.30[10]	1.5
Mining, loading, hauling to parting, laying straight track and timbering, per ton		0.845[12]	0.770[12]						
Jackhammers furnished, rooms, per ton									
Entries and crosscuts, room necks and crosscuts									
Coal 2 ft. thick, per ton									
1¾ to 2 ft., per ton									
2 to 2¼ ft., per ton									
2 to 2½ ft., per ton									
2¼ to 2½ ft., per ton									
2⅝ to 3 ft., per ton									
Over 2½ ft., per ton									
2½ to 2¾ ft., per ton							0.8100		
2¾ to 3 ft., per ton									
2¾ to 3¼ or 3½ ft., per ton							0.7700		
3 to 3½ ft., per ton									
3 to 3⅝ ft., per ton									
Over 3 ft., per ton									
Over 3¼ or 3½ ft., per ton							0.6800		
3½ to 4 ft., per ton									
3⅝ to 4⅛ ft., per ton									
Under 4 ft., per ton									
4 to 5 ft., per ton									
Over 4 ft., per ton									
Over 4⅛ ft., per ton									
Under 5 ft., per ton									
Over 5 ft., per ton									
5 to 6 ft., per ton									
Over 6 ft., per ton									
Under 7 ft., per ton				0.680					
7 to 10 ft., per ton				0.650					
Over 10 ft., per ton				0.620					
Cap rock left up, per ton									
Under 6 in. taken, per ton									
6 to 12 in. taken, per ton									
Pillar work, per ton									
Per car									
Coal under 2½ ft., per ton									
Over 2½ ft., per ton									
Under 5 ft., per ton									
Over 5 ft., per ton									
On pitch, per car									
On flat, per car									
Splitting pillars, flat work, per car									
Boom pillars, per car									
Gangways, 8 ft. wide, per car									
Chute work, 8 ft. wide, per car									
Under 10 ft., per car									
Chutes above gangway counters, per car									
Counters, per car									
YARDAGE—PICK MINING:									
Narrow work and entries, per yd									2.3
Double-shifted, extra per yd								0.25	0.2
7-ft. places, per yd									
7- to 9-ft., per yd							1.8000[18]		
8-ft., per yd	2.25				1.5840	2.490		1.79	2.5
8-ft., no brushing, per yd									
Up to 6 in. brushing									
Over 6 in. brushing									
Over 8 ft., per yd									
10-ft., per yd						2.340			
12-ft., per yd	1.68				1.0260	1.790	1.1300[21]	1.39	1.7
Under 12½-ft., per yd				1.470					
14-ft., per yd								1.35	
Cap rock left up., per yd									
16-ft., per yd	1.12								
20-ft., per yd						0.740			
Entries driven through fault, per yd				13.460					
Gangways, including timbering, per ft									
Standard size, per ft									
Parting size, per ft									
Gangway counters, per ft									
Slants, per ft									
For haulageways, per yd									
Chutes above gangway counters, per ft									
Chutes, angle, and dogholes, pillar booming, per ft									
Chutes, temporary, per ft									
Aircourses and airways, per yd									
Uphill, per yd									
Slope sinking, per yd									
Parallel airways, per yd									
Rooms, 11 to 13 ft., per yd									
13-16-ft., per yd									
Rooms and breasts over 350 ft. deep, per yd									
Entry crosscuts and breakthroughs, per yd	1.68						1.8000		
Under 12½ ft. wide, per yd				1.470					
Room crosscuts and breakthroughs, per yd	1.68						1.8000[35]		
Under 12½ ft. wide, per yd				0.970					
Downhill, under 40 ft., per yd									
Over 40 ft., per yd									
Uphill, under 50 ft., per yd									
Over 50 ft., per yd									
Crosscuts, room or chute, above 1st counter or crosscut, 1st 30 ft., per yd									
Over 30, up to 50 ft., per yd									
Crosscuts, slope to airway, per yd									
Crosscuts, 6 ft. wide, 1st 30 ft., per yd									
Over 30 ft., per yd									
Crosscuts, under 30 ft., per yd									
30 to 40 ft., per yd									
Crosscuts, per ft									
Under 35 ft., per ft									
Over 35 ft., per ft									
Pillar work, per sq. ft									
Batteries, single, per 6 ft									
Double, per 6 ft									
Corner cutting, per yd									

ork Scales Included in Union Contracts

stated in dollars. Tonnage rates are based on the ton of 2,000 lb. Union districts corresponding to the respective fields are shown in paren

wa (13)		Kentucky-Tennessee						West Virginia									
Other Iowa†	Kansas-Missouri (14)††	Big Sandy-Elkhorn(30)†††	Hazard (30)	Harlan (19)	Southern Appal. (19)	Tenn.-Ga. (19)‡	Virginia (28)	Greenbrier (17)	New River (17)	Pocahontas-Tug River (17)	Winding Gulf (17)	Kanawha (17)	Logan (17)	Williamson (17)	W. Va.-Md.: Georges Creek-Upper Potomac (16)†††	Western Kentucky (23)‡‡	Michigan (24)
0.81 [3]			0.482				0.475	0.447	0.517		0.454	0.492	0.384	0.414	0.622 [4]		
1.54 [11]																	
						0.78											
																	1.14000
																	0.98860
						0.73											
																	0.95030
				0.520													
																	0.91200
					0.600												
					0.560	0.68											
					0.530												
				0.480													
						0.63											
					0.500												
				0.440													
		0.545															
		0.400			0.470												
				0.400													
											0.492						
						0.65											
						0.60											
2.32 [15]																	1.68360
0.25																	0.28520
2.57 [19]																	
1.75 [22]																	
						0.52											
						0.52											1.6836 [30]
																	1.2420 [30]

Contracts for Various Bituminous Fields

respective fields are shown in parentheses)

	Williamson (17)	W. Va.-Md.: Georges Creek-Upper Potomac (16)†††	Western Kentucky (23)‡‡	Michigan (24)	Ray & Clay Cos., Missouri (25)‡‡‡	Montana (27)	Ohio-No. West Virginia: Hocking (6)	Coshocton (6)	Massillon (6)	E. Ohio & No. W. Va. Panhandle (6)	Pennsylvania: Central and Somerset Co. (2)	Western: Thin Vein, District 5	Western: Thick Vein (5); Districts 3 & 4	Utah (22)	Washington (10)§	No. W. Va. (31)	Wyoming (22): Southern§§	Wyoming (22): Northern§§§
84	0.414	0.622[4]			1.2100[5]	0.8260	0.70000	0.8000	0.80	0.7000	0.700[6]	0.700	0.650[7]		0.880[8]	0.560	0.6800[9]	0.67
															0.800			
																	0.750	
																	0.880	
				1.14000														
				0.98860														
				0.95030														
				0.91200														
														0.690				
																	0.800[13]	
														0.650			0.700	
																	0.710	
																	0.680	
															0.880			
															0.930			
															0.950			
																0.460		
															0.650			
														0.590				
														0.550				
															0.900			
															1.050			
															1.150			
															0.420			
															1.250[8]			
															1.350			
															1.200			
															1.100			
															1.200[14]			
				1.68360		2.9500	0.02304[16]	2.07[17]	2.07[17]			1.130	1.130				2.00	2.20
				0.28520									0.250					
					1.6425													
															3.110[20]			
															1.920			
															2.380			
															3.110			
					1.6400													
					1.4775										2.655[23]			
															1.700			
															0.500			
															5.590[24]			
															7.750[25]			
															2.810[26]			
															0.600			
						2.9500												
															2.000[27]			
															0.750[28]			
															2.080[29]			
															1.700			
																	2.87	
															3.390			
															1.470			
															0.545			
															0.430			
															0.465			
				1.6836[30]		1.45[31]	0.02304[16]	2.07[32]	2.07[32]								2.00[33]	2.20[34]
				1.2420[30]		1.45[31]	0.02304[16]	1.10[36]	1.10[36]						1.470[18]		1.70[37]	2.15[38]
															1.470			
															2.290			
															1.470			
															2.290			
															0.450			
															0.450			
															1.470			
															0.600			
															1.000			
															3.000			
															3.450			
															1.500[39]			
															1.280[40]			
															1.360[41]			
															0.115[42]			
															0.180			
					[illegible]										0.540			

Over 30, up to 50 ft., per yd.
Crosscuts, slope to airway, per yd.

Over 30, up to 50 ft., per yd									
Crosscuts, slope to airway, per yd									
Crosscuts, 6 ft. wide, 1st 30 ft., per yd									
Over 30 ft., per yd									
Crosscuts, under 30 ft., per yd									
30 to 40 ft., per yd									
Crosscuts, per ft									
Under 35 ft., per ft									
Over 35 ft., per ft									
Pillar work, per sq. ft									
Batteries, single, per 6 ft									
Double, per 6 ft									
Corner cutting, per yd									
ROOM TURNING—PICK MINING:									
General rate	3.39				3.9420				
Per yd									
7 to 9-ft., neck, 12 ft. deep, widened to 45 deg							4.3500		
12-ft. neck							2.7200		
8-ft. neck, 9 ft. deep						7.230			5.2
12-ft. neck						3.550			
8-ft. neck, 18 ft. deep									
Under 9-ft. neck									5.8
12 to 14-ft. neck								2.33[49]	
Over 12-ft. neck						3.550			
15-ft. neck									
Neck 20 ft. deep									
30 ft. deep									
40 ft. deep									
50 ft. deep				4.490					
60 ft. deep									
DEADWORK—PICK MINING:									
Drawslate, over 3 in., in rooms, per in. per yd. 5 ft. wide	0.02								
Over 12 in., per in. per yd									
Top material, 2 to 5 in., each 10x10-ft. section, per ton of coal									
5 to 9 in., per ton of coal									
9 to 13 in., per ton of coal									
Float rock, bottom, under 8 in., per ton of coal									
Rock or slate in seam, over 3 in., per ton of coal per in.									
Rock in seam, under 5 in., per yd				0.250					
Each additional in., per yd				0.040					
Rooms, 8 to 14 in., per yd				0.490[43]					
14 to 18 in., per yd				0.52 [43]					
18 to 22 in., per yd				0.69 [43]					
Each additional inch, per yd				0.04 [43]					
Brushing, top or bottom, entries, per cu. yd				0.970					
Rooms, per cu. yd				0.970					
Brushing, bottom, entries, 22 in., 5 ft. wide, per yd									
Over 22 in., 5 ft. wide, per in. per yd									
Brushing, entries, low coal, per yd									
Brushing top or bottom, entries, 5 ft. wide, per in. per yd									0.0
Brushing, entries, per 12 in. of material, 9 ft. wide, under 30 in. of coal, slate, per yd									
Over 30 in. of coal, per yd									
Slate and rock, under 30 in. coal, per yd									
Over 30 in. of coal, per yd									
Sandrock, under 30 in. of coal, per yd									
Over 30 in. of coal, per yd									
Brushing, up to 2 ft., 8-ft. gangways, including track and timbering, per yd									
Small 4-piece timber sets, each									
Heavy 3-piece sets, 9-ft. collars, each									
3-piece sets, under 9-in. timbers, each									
Room brushing, per in. per yd									
Taking roof, per yd									
Rock shooting and handling, per yd									
Sticky slate, 10 ft., per ton of coal									
Over 10 ft., per ton of coal									
Rolls, over 6 in., per cu. ft							0.0410		
Clay veins, 6 to 12 in., each									
Over 12 in., per ft									
At angle, per yd									
Spar, under 6 in. each									
At angle, per yd									
Horsebacks, per ft						2.850			
2 to 6 in					2.0160				
Each additional inch					0.1632				
Gob entries, under 18 in. lifted, 10 ft. wide, per yd									
Rock tunnels, per ft									
Timber sets, each									
Rock counters and crosscuts, per ft									
Chutes, permanent, and bulkhead, each									
Building walls, single, per yd									
Double per yd									
Loading rock or water, per car				0.49 [55]					
Loading or unloading slate, per car									0.1
Hauling coal, under 900 ft., per car									
900-2,000 ft., per car									
Hauling coal with mules, per ton				0.050 [56]					
Hauling rock with mules, per car				0.070					
Handling cars, over 50 ft. from entry, per car									
Pushing, up to 300 ft., per car									
300-600 ft., per car									
Setting crossbars, rooms				0.250 [57]					
Entries				0.490 [57]					
Recovering props, per ft				0.010					
Building cribs, each									
4-ft., each				0.410					
5-ft., each				0.540					
Setting timbers chute work over 10 ft., 4 piece sets, each									
Setting crossbars and split props, rooms, each									
Setting timbers over 8 in. when unloaded over 50 ft. from working place, each									
LOADING—MACHINE-MINED COAL:									
General rate, per ton		0.585	0.55		0.6800	0.555		0.82	
Entries, including yardage, room-turning and deadwork, per ton	0.74								
Rooms and crosscuts, per ton	0.58								
Rooms over 300 ft. deep, per ton	0.61								
Screened-lump basis, per ton									0.9
After punching machines, per ton							0.4250		
After chain machines, per ton							0.4750		
Coal 2½ to 3 ft., per ton									
2½ to 2¾ ft., per ton									
2¾ to 3 ft., per ton									
3 to 3½ ft., per ton									
3 to 3⅔ ft., per ton									
3½ to 4 ft., per ton									
3⅔ to 4½ ft., per ton									
Under 4 ft., per ton									
Over 4 ft., per ton									
Over 4⅓ ft., per ton									
Under 5 ft., per ton									
Over 5 ft., per ton									
Cut by shortwall, under 4 ft., per ton				0.510					
Over 4 ft., per ton				0.50 [65]					
Including drilling, rooms, per ton									
Wide work, 12 in. drawslate, per ton									
No drawslate, per ton									
Narrow work, 12 in. drawslate, per ton									
Entries, per ton									
Crosscuts and breakthroughs, per ton									
Including shearing, per ton									
Including shooting, per ton		0.585[65]							
Rooms, dry, per ton									
Wet, per ton									
Entries, dry, per ton									
Wet, per ton									
Including drilling and shooting, per ton									
Coal over 5 ft., per ton									
Places under 12 ft., per ton									
Over 12 ft., per ton									
Wide work (over 15 ft.; 18 ft. in rooms), per ton									
Including timbering, drilling, shooting and track, cap rock under 6 in., per ton									
Cap rock, 6 to 12 in., per ton									
Entries and crosscuts, per ton									
Entries over 18 ft., per ton									
Including drilling, shooting and explosives, per ton									0.6
Including timbering, per ton									
Including tracklaying and timbering, per ton									
Including track, timbering, care of places, rooms, dry									

																	3.60180
5.23 [48]																	
5.84 [48]																	
0.059[52]																	
						0.80											
						0.60											
						0.85											
						0.65											
						0.95											
						0.75											
						0.02											
0.18 [52]																	
	0.550		0.402				0.408	0.392	0.442	0.357	0.384	0.422	0.332	0.358	0.450 [58]	0.3600[59]	
0.94 [61]																	
				0.440[62]													
					0.500[63]												
					0.460[63]												
					0.430[63]												
				0.410[62]													
					0.400[63]												
				0.380[62]													
		0.465[64]															
		0.420[64]			0.370[63]												
				0.350[62]													
																	0.69000[66]
																0.3800	0.6992 [66]
																	0.6992 [66]
0.62 [71]																	
																0.2900	

Including tracklaying and timbering, per ton

Including track, timbering, care of places, rooms, dry

																	1.000			
																	3.000			
																	3.450			
																	1.500[39]			
																	1.280[40]			
																	1.360[41]			
																	0.115[42]			
																	0.180			
																	0.540			
							0.86[44]													
						3.60180													1.70[45]	2.15[38]
										3.1700										
										4.2100[47]										
								7.2600												
																	7.80			
																	8.72			
																	9.63			
																	15.28			
														0.054	0.054[50]					
							0.006													
							0.36[51]													
							0.06													
							0.080													
																0.0067			0.0067	
							1.01													
							0.06												1.8000	
																	1.75			
																	0.75			
																	2.50			
																	2.00			
														0.170	0.170					
							2.41[53]													
							0.60													
							0.120													
														2.480	2.480					
														2.480	2.480					
														0.640	0.640					
														1.480	1.480					
														0.270	0.270					
							1.77[54]													
																	7.00			
																	4.36			
																	7.00			
																	10.80			
							0.290													
							0.560												0.6700	
																	0.05			
																	0.08			
																	0.05			
																	0.05			
																	0.08			
							0.582													
																	1.000			
																	0.930			
																	0.295			
	0.422	0.332	0.358	0.450[58]	0.3600[59]		0.726[60]						0.520					0.400		
																0.590				
																0.550				
						0.69000[66]			0.52000											
														0.520	0.480					
															0.440[67]					
														0.520	0.480					
					0.3800	0.6992[66]			0.52000											
						0.6992[66]			0.52000											
																				0.54[69]
																				0.57[69]
																				0.57
																				0.60
										0.5450	0.545								0.550	0.55
								0.6550												
								0.6075												
												0.52[70]								
																	0.630			
																	0.650			
																	0.660			
																	0.705			
					0.2900															
																0.400				
... and crosscuts, per ton														0.58						
Rooms over 300 ft. deep, per ton														0.61						
Screened-lump basis, per ton																				
After punching machines, per ton																				0.4250

......	0.550	......	0.402	......	......	.....	0.408	0.392	0.442	0.357	0.384	0.422	0.332	0.358	0.450 [55]	0.3600[59]	....
......	......	......	.....	......	......	.....	.....	.....	.....	.....	......	......	.....	.....	....	....	....
0.94 [61]	......	......	.....	......	......	.....	.....	.....	.....	.....	......	......	.....	.....	....	....	....

CLASSIFICATION*	Ark.-Okla. (21)**	No. Colo. (15)		So. Colo.-New Mexico (15)***	Illinois (12)		Indiana (11)****	Iowa (	
		Louisville	Erie-Frederick		Fulton-Peoria	Springfield		Wayne & Appanoose Counties	
Rooms and crosscuts, per ton	0.58								
Rooms over 300 ft. deep, per ton	0.61								
Screened-lump basis, per ton									0.
After punching machines, per ton							0.4250		
After chain machines, per ton							0.4750		
Coal 2⅓ to 3 ft., per ton									
2½ to 2¾ ft., per ton									
2¾ to 3 ft., per ton									
3 to 3½ ft., per ton									
3 to 3⅔ ft., per ton									
3½ to 4 ft., per ton									
3⅔ to 4⅓ ft., per ton									
Under 4 ft., per ton									
Over 4 ft., per ton									
Over 4½ ft., per ton									
Under 5 ft., per ton									
Over 5 ft., per ton									
Cut by shortwall, under 4 ft., per ton				0.510					
Over 4 ft., per ton				0.50 [85]					
Including drilling, rooms, per ton									
Wide work, 12 in. drawslate, per ton									
No drawslate, per ton									
Narrow work, 12 in. drawslate, per ton									
Entries, per ton									
Crosscuts and breakthroughs, per ton									
Including shearing, per ton									
Including shooting, per ton		0.585[68]							
Rooms, dry, per ton									
Wet, per ton									
Entries, dry, per ton									
Wet, per ton									
Including drilling and shooting, per ton									
Coal over 5 ft., per ton									
Places under 12 ft., per ton									
Over 12 ft., per ton									
Wide work (over 15 ft.; 18 ft. in rooms), per ton									
Including timbering, drilling, shooting and track, cap rock under 6 in., per ton									
Cap rock, 6 to 12 in., per ton									
Entries and crosscuts, per ton									
Entries over 18 ft., per ton									
Including drilling, shooting and explosives, per ton									0.
Including timbering, per ton									
Including tracklaying and timbering, per ton									
Including track, timbering, care of places, rooms, dry									
Wet, per ton									
Entries, dry, per ton									
Wet, per ton									
Including cutting, hauling, straight track and timbering, per ton		0.800[12]	0.710[12]						
Over 300-ft. rooms, per ton									
Cardox furnished, entries, per ton	0.67								
Rooms and crosscuts, per ton	0.51								
Company drilling, per ton									
Drilling and shooting, per ton									
Entries, per ton	0.64								
Rooms and crosscuts, per ton	0.48								
Rooms over 300 ft., per ton	0.51								
Shearing, per ton									
Cutting and shearing, per ton				0.455					
Cutting, shearing and drilling, per ton									
Cutting, shearing, drilling and shooting, per ton									
Drilling and shearing, per ton									
Shoveling only, per ton		0.38 [75]	0.380						
Including straight track and timbering, per ton		0.42							
YARDAGE—MACHINE MINING:									
Entries or narrow work, chain machine, per yd							1.1300[77]		
6-ft. places, per yd									
12-ft. places							0.0710[77]		
15-ft. places									
Entries, narrow (7-9 ft.), punching machine, per yd							1.0960[77]		
Wide (12 ft.), per yd							0.6890[77]		
Entries or narrow work, per yd									
Double-shifting, extra, per yd									
7-ft. places, per yd									
8-ft., per yd					1.2660	1.330			1.
10-ft., per yd						1.140			
Under 12 ft., per ft		0.478	0.440						
Per yd									
12 ft., per yd					0.8700	0.950			0.
Under 12½ ft., per yd				1.50 [82]					
Heavy pitch, per yd				1.75 [83]					
Light pitch, per yd				1.50 [83]					
14 ft., per yd									
20 ft., per yd						0.380			
Rooms, 12-15 ft., per yd									
12 to 18 ft., per yd									
Crosscuts or breakthroughs, entry, per yd									
Under 12½ ft. wide, per yd				0.97 [84]					
Heavy pitch, per yd				1.50 [83]					
Light pitch, per yd				0.97 [83]					

* Where a rate for machine mining or cutting is shown in any agreement, yardage and deadwork rates, in the absence of specific information to the contrary, are included under the appropriate headings in the machine section of the table, even though they may apply to pick mining also.

** Tahona (Okla.) machine scale; Huntington (Ark.) solid-shooting scale.

*** Colorado Fuel & Iron Co. scale. Rates included in the agreement (as they may apply at the Cameron, Crested Butte, Frederick, pick mining; Kebler, Morley, pick mining; and Nonac operations) are among the highest paid in the field and correspond in general to the rates paid by most of the other larger companies.

**** Does not include the Brasil Block field (District 8) and the temporary adjustment in Vandenburg and Warrick counties.

† Includes Subdistricts 2, 3 and 4.

†† Cherokee and Crawford counties, Kansas; Barton County, Missouri

††† Yardage and deadwork seales (varying from mine to mine) not available.

‡ Hamilton and Rhea counties, Tennessee; Georgia. Tonnage, yardage and deadwork rates for the southern Tennessee field not available.

‡‡ Ohio and Muhlenberg counties only.

‡‡‡ Rates as they may apply in the Richmond and Swanwick fields and at the operations of the Clay County, Elmira, Fairplay, Johnson, Missouri City, Mosby, Rayville and Vibbard companies.

§ Rates as they may apply at the operations of the Big Four, Bucoda (day work), Dale (day work), Northwestern Improvement, Pacific Coast, Roslyn-Cascade and West Coast companies.

§§ Rates as they may apply at the operations of the Blazon, Central Coal & Coke, Colony, Diamond Coal & Coke, Gunn-Quealy, Kemmerer, Lion, Megeath and Rock Springs Fuel companies, in accordance with agreement between the United Mine Workers and the Southern Wyoming Coal Operators' Association.

§§§ Rates as they may apply at the operations of the Hotchkiss, Sheridan and Sheridan-Wyoming coal companies.

[1] Black Diamond mine, 75c.; Crown, 78c.

[2] Illinois agreement includes the following rates; Subdistrict No. 1—Streator, Verona, Fairbury and associated mines, 77c.; Subdistrict 2—Danville, Westville, Grape Creek and associated mines in Vermillion County, 68c. (basic rate); Subdistrict 3—Springfield, Dawson and associated mines, 68.7c.; Lincoln, Niantic and Colfax, 72c.; Subdistrict 4—Mines of the C. & A. south of Springfield to and including Carlinville, including Taylorville, Pana, Tower Hill, Litchfield, Hillsboro, Witt (Paisley), Divernon, Pawnee, Nokomis and Kincaid, 68c.; Assumption longwall, including 24 in. of brus
Decatur longwall, pre
Subdistrict 5—Glen C
including Percy, Pinck
ft. and under, 73c.; Di
and associated mines,
Jackson County, 64c
shipping mines, lower
Gallatin, Williamson
ton and Peoria counti
ditions, 97c.; No. 5 ve
Keewanee and Etherly
Pekin, shipping mines
lespie, Benld, Sorento,
line east to and includi
to Beckmeyer, 68c.; c
Illinois, 7c. per ton, ex
per ton. Tonnage, yar
above not available.

[3] Subdistrict No. 2;
and Waynesburg seam
mines until they take
Swanwick, 12½c.; Cam

(cut off)	Other Iowa†	Kansas-Missouri (14)††	Big Sandy-Elkhorn (30)†††	Hazard (30)	Harlan (19)	Southern Appal. (19)	Tenn.-Ga. (19)‡	Virginia (28)	Greenbrier (17)	New River (17)	Pocahontas-TugRiver (17)	Winding Gulf (17)	Kanawha (17)	Logan (17)	Williamson (17)	W. Va.-Md.: Georges Creek-Upper Potomac (16)†††	Western Kentucky (23)‡‡	Michigan (24)
		0.550		0.402				0.408	0.392	0.442	0.357	0.384	0.422	0.332	0.358	0.450 [58]	0.3600[59]	
	0.94 [61]																	
					0.440[62]													
						0.500[63]												
						0.460[63]												
						0.430[63]												
					0.410[62]													
						0.400[63]												
					0.380[62]													
			0.465[64]															
			0.420[64]			0.370[63]												
					0.350[62]													
																		0.69000[65]
																	0.3800	0.6992 [66]
																		0.6992 [66]
	0.62 [71]																	
																	0.2900	
																	0.2700	
		0.830																
		0.560																
		0.420																
		0.300																
	1.03 [80]																	
	0.70 [81]																	
		0.280																

Column groups: ...wa (13) [Other Iowa]; Kentucky-Tennessee [Big Sandy-Elkhorn, Hazard, Harlan, Southern Appal.]; West Virginia [Greenbrier through Williamson].

brushing, 94c.; Moweaqua room-and-pillar, 72c.; , present conditions, 83c.; room-and-pillar, 77c.; en Carbon, Belleville and associated mines, to and Pinckneyville, Wellsville and Nashville, 68c.; coal 5 ; District 6—DuQuoin, Odin, Sandoval, Centralia nes, 64c.; Salem and Kinmundy, 69c.; District 7— 64c.; coal under 5 ft., 69c.; Jackson County wer bench, 14 in. of brushing, 77c.; Saline, White, on and Franklin counties, 64c.; District 8—Ful- unties, Third or lower vein coal, Third Vein con- 5 vein, 75c.; Astoria No. 5 vein, 75c.; No. 6 vein, nerly conditions, undercutting and wedging, 84c.; ines, 75c.; District 9—Mt. Olive, Staunton, Gil- nto, Coffeen, Worden and mines on the Vandalia cluding Smithboro and on the B. & O. S. W. east c.; coal under 5 ft., 73c. Machine differential in n, except in the Danville district, where it is 10c. , yardage and deadwork rates in addition to the le.

. 2; No. 3, 83½c.; No. 4, $1.496. [4] Bakerstown seams, 68c. [5] Elmira, $1.3035. Extra at new ake weight, Rayville, 12c. per ton; Richmond- Camden and Fairplay, 12.6c. Elmira, rooms to be turned 36 ft. wide, length not to exceed 180 ft.; for each foot in excess of 5 ft. over 18 ft. from center to either side, 0.9c. per ton extra. Sticky slate, 10 ft., Richmond-Swanwick, 6c. per ton extra; over 10 ft., 12c. per ton.

[6] Somerset agreement, pickhammer rate, mines of the Berwind-White Coal Mining Co., 60c. per ton, subject to investigation and arbitration. [7] Connellsville, 56c. [8] Also $1. [9] Kemmerer, 67c. [10] Rooms 150 ft. deep; first 20 ft. over, 10½c. per ton extra; over 170 ft., 15c. per ton extra.

[11] Subdistrict No. 4 only. Extra payments, pushing over 150 ft., 9c. per ton for the first 30 ft. over; rooms over 50 ft. wide, 1c. per ton. [12] Isolated sections. [13] Also 76c. [14] Also $1.35. [15] Subdistrict No. 4, including breakthroughs.

[16] In addition to pick-mining rate. [17] Wet places, 39c. per yard extra. [18] Also entries up to and including 11 ft. [19] Subdistrict No. 2, including breakthroughs; No. 3, $2.04 per yd.; 8-ft. entries, $2.05; no scale in No. 4. Deficiency scale in Subdistrict No. 2: deficient on account of rock or other impurities, per yard, including coal—3½- to 4-ft. coal, $5.50; 4- to 5-ft., $6.08; 5- to 6½-ft., $6.58; 6½- to 8-ft., $7.16; where there is insufficient coal to cut—3½- to 4-ft. coal, $6.06; 4- to 5-ft., $6.65; 5- to 6½-ft., $7.16; 6½- to 8-ft., $7.85. In lieu of above scales, deficient work may be done for $3.39 per yard and the coal. [20] Also $3.12.

[21] Also applies to 14 ft. or over. [22] Subdistrict N breakthroughs; No. 3, $2. [23] Including brushing. [25] Also $6.81.

[26] Also $2.40. [27] Also $2.04; $2.33; $2.39; $2.65. [29] Also $2.10 and $2.33. [30] Breakthroughs betwe rooms, $1.6836 per yard; between rooms and entri

[31] When driven over 30 ft. from one side, entry pri for excess. [33] Wet places, 39c. per yard extra. Glencoe, $2.40; same for Kemmerer, including [34] Handling coal over 17 ft. from nearest rail, $1.3 picking down top, 55c. per yard extra. [35] Wh blocked.

[36] Per yard, over 14 ft., $2.07; wet places, 39c. p [37] Includes planes and plane crosscuts; Kemmerer Blazon, $2.20. [38] Handling coal over 17 ft. from ne per yard extra; picking down top, 55c. per yard ex 55c. per yard extra. [39] Also $1.53. [40] Also $1.35 [41] Also $1.46 and $1.50. [42] Also 12c. and 13c. brushing. [44] Rayville and Elmira, 81½c.; Camden, 8 merer, Glencoe and Blazon, $2.40 per yard.

[46] Subdistrict 2, rooms to be considered turned w and 18 ft. wide at the face; when neck is required than 3 ft. on one side, $2.32 shall be paid; Subdistri

	Logan (17)	Williamson (17)	W. Va.-Md.: Georges Creek-Upper Potomac (16)†††	Western Kentucky (23)‡‡	Michigan (24)	Ray & Clay Cos., Missouri (25)‡‡‡	Montana (27)	Ohio-No. West Virginia: Hocking (6)	Ohio-No. West Virginia: Coshocton (6)	Ohio-No. West Virginia: Massillon (6)	Ohio-No. West Virginia: E. Ohio & No. W. Va. Panhandle (6)	Pennsylvania: Central and Somerset Co. (2)	Pennsylvania: Western: Thin Vein, District 5	Pennsylvania: Western: Thick Vein (5); Districts 3 & 4	Utah (22)	Washington (10)§	No. W. Va. (31)	Wyoming (22): Southern§§	Wyoming (22): Northern§§§
422	0.332	0.358	0.450[58]	0.3600[59]	......	0.726[60]	......	......	......	......	......	0.520	......	......	......	......	0.400	......	......
															0.590				
															0.550				
					0.69000[66]			0.52000					0.520	0.480					
														0.440[67]					
													0.520	0.480					
				0.3800	0.6992[66]			0.52000											
					0.6992[66]			0.52000											
																			0.54[69]
																			0.57[69]
																			0.57
																			0.60
									0.5450	0.545									
																		0.550	0.55
							0.6550												
							0.6075												
											0.52[70]								
																0.630			
																0.650			
																0.660			
																0.705			
				0.2900															
															0.400				
																			0.47[72]
																			0.49[72]
																			0.49
																			0.52
													0.5075	0.4675			0.380		
																		0.4600	
																		0.6200	
																		0.6000	
													0.5025	0.4625			0.355		
											0.5000								
											0.4875[73]								
											0.4200[74]								
													0.4900	0.4500			0.335		
				0.2700			0.5350											0.4900[76]	
								0.504[78]					0.5000	0.5200[79]					
						1.6425													
									1.1100	1.110	0.6480								
									0.6550	0.655									
															0.930				
									0.4350	0.435	0.5040								
						1.4775													
									0.4350	0.435									
								0.504[78]							0.930				

[21] Also applies to 14 ft. or over. [22] Subdistrict No. 2, including breakthroughs; No. 3, $2. [23] Including brushing. [24] Also $4.81. [25] Also $6.81.

[26] Also $2.40. [27] Also $2.04; $2.33; $2.39; $2.65. [28] Also 85c. [29] Also $2.10 and $2.33. [30] Breakthroughs between entries and rooms, $1.6836 per yard; between rooms and entries, $1.4582.

[31] When driven over 30 ft. from one side, entry price shall be paid for excess. [32] Wet places, 39c. per yard extra. [33] Blazon and Glencoe, $2.40; same for Kemmerer, including entry slants. [34] Handling coal over 17 ft. from nearest rail, $1.33 per yard extra; picking down top, 55c. per yard extra. [35] When sheared or blocked.

[36] Per yard, over 14 ft., $2.07; wet places, 39c. per yard extra. [37] Includes planes and plane crosscuts; Kemmerer, Glencoe and Blazon, $2.20. [38] Handling coal over 17 ft. from nearest rail, $1.33 per yard extra; picking down top, 55c. per yard extra; wet work, 55c. per yard extra. [39] Also $1.53. [40] Also $1.35 and $1.50.

[41] Also $1.46 and $1.50. [42] Also 12c. and 13c. [43] Or bottom brushing. [44] Rayville and Elmira, 81½c.; Camden, 86½c. [45] Kemmerer, Glencoe and Blazon, $2.40 per yard.

[46] Subdistrict 2, rooms to be considered turned when 18 ft. deep and 18 ft. wide at the face; when neck is required to be cut more than 3 ft. on one side, $2.32 shall be paid; Subdistrict 3, same rule as to room turning and cutting on one side; each additional yard over 18 ft., $1.74. [47] Over 18 ft. deep, entry yardage rate to apply; wet places, 39c. per yard extra. [48] Subdistrict 4. [49] Where neck is required to be cut more than 9 ft. on either side, entry yardage price shall apply. [50] No scale for Thick Vein Freeport.

[51] Rayville, 5 to 9 in., 3.5625c. [52] Subdistricts 2 and 3. [53] Rayville, $3; Camden, $2.21; Fairplay, $2.42. Entries to be 5½ to 6 ft. high, 4 ft. wide at top, 10 ft. at bottom, including building 3-ft. walls and wheeling not over 300 ft. [54] Rayville, $1.695. [55] Frederick, 56c.

[56] Frederick, 3c. [57] Frederick, rooms, 21c.; entries, 37c.

[58] Bakerstown seam, 57c.; Waynesburg seam, 52c.; Mine No. 23, Davis Coal & Coke Co.—handling top coal in headings, rooms and aircourses, 15c. per ton extra; heading yardage, 90c. up to 24 in. in thickness, plus 3.6c. per inch in excess of 24 in. [59] Subject to review. [60] Clay County and Mosby, 87c. Extra, new mines until they take weight, Rayville, Clay County and Mosby, 12c. per ton; Richmond-Swanwick, 12½c.; Missouri City, 12.6c. Elmira, rooms shall be turned 30 ft. wide; for each foot in excess of 5 ft. over 18 ft. from the center, 0.9c. extra per ton; length of room shall not exceed 180 ft.

[61] Subdistrict 4, including shooting and explosives. [62] Company drilling, shooting and explosives, 7c. per ton shall be deducted; company drilling, 2c.; company shooting, 1c.; company furnishing explosives, 4c. Loading coal in places under 12 ft. wide, 3c. per ton extra, except where company shoots or shears. [63] Entry coal, 3c. per ton extra, in lieu of rib yardage. [64] Includes 6 in. of drawslate, drawrock or impurities. [65] Nonac, 55c.

[66] Low-coal differentials: 21-24 in., 12.6c. per ton; 24-27 in., 5.4c.; 27-30 in., 2.73c. All places under 18 ft. wide to be paid at entry prices. [67] All districts where drawslate is supported by top coal. Where drilling is done by company, 42½c.; shearing, 42½c.; drilling and shearing, 41c. [68] Crown mine. [69] Where necessary to use snubbing rope in rooms, 1c. per ton extra. Crosscuts, $1.06 per yard in addition to tonnage payments. [70] Amsterdam-Bergholz district, coal under 4 ft., 54c.; where drilling is done by company, 51.3c.

[71] Subdistrict No. 2; No. 3, 82c.; No. 4, 89.6c. Also applies in breakthroughs. [72] Where necessary to use snubbing rope in rooms, 1c. per ton extra. [73] Northern West Virginia Panhandle only. [74] Wide work; includes tracklaying. [75] Crown mine, 60c.

[76] Coal under 5 ft. [77] Also breakthroughs in entries and in rooms when of similar width. [78] In addition to tonnage rate of 52c. [79] Thick Freeport seam, District 5, 28½c. per yard. [80] Subdistrict No. 2; No. 3, 82c.; includes breakthroughs.